news, knowledge, advice

SCIENCE DIGEST

APRIL 1967 • 50 CENTS ICD

SPECIAL REPORT:

HOW MUCH CAN YOUR BODY TAKE?

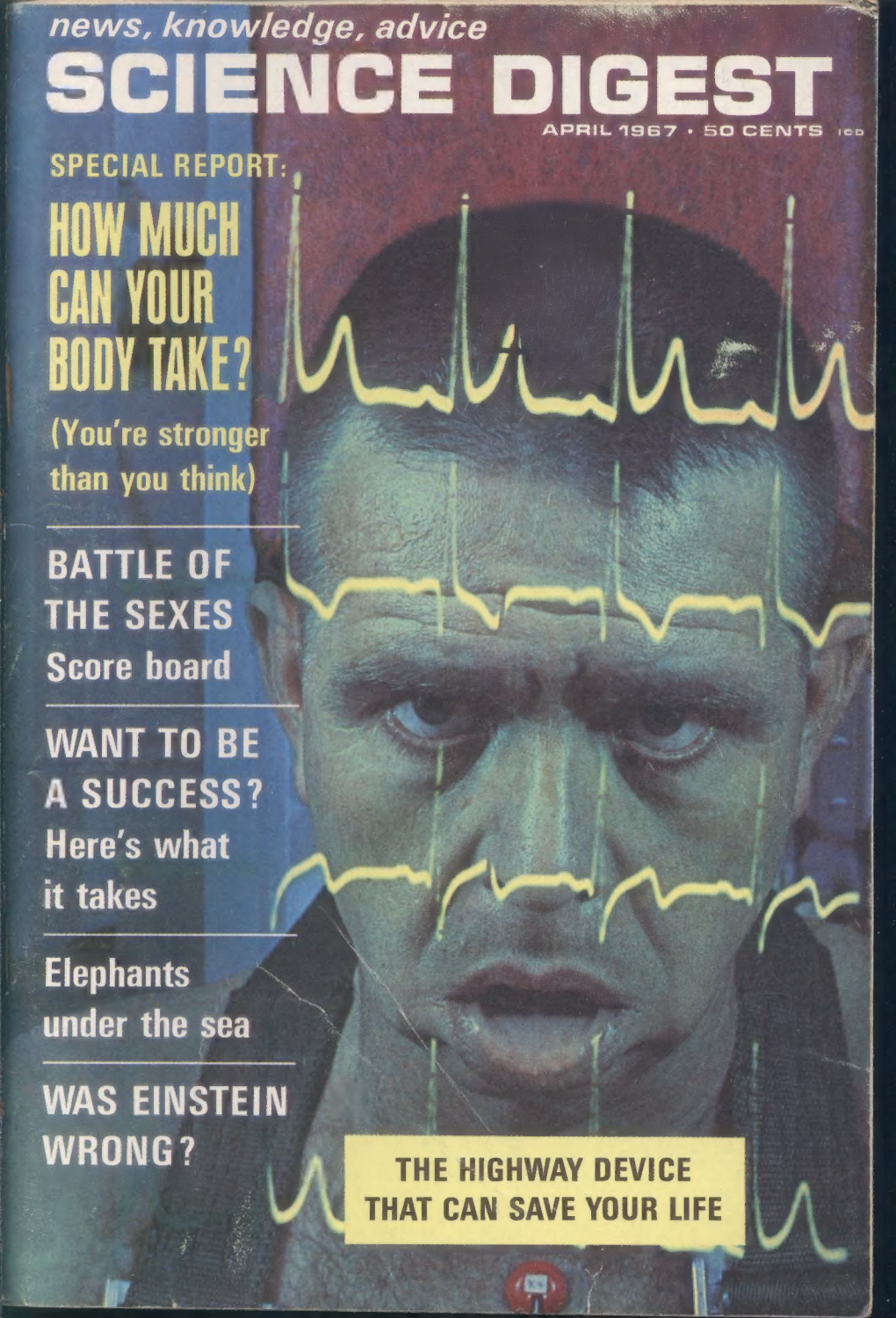
(You're stronger than you think)

BATTLE OF THE SEXES
Score board

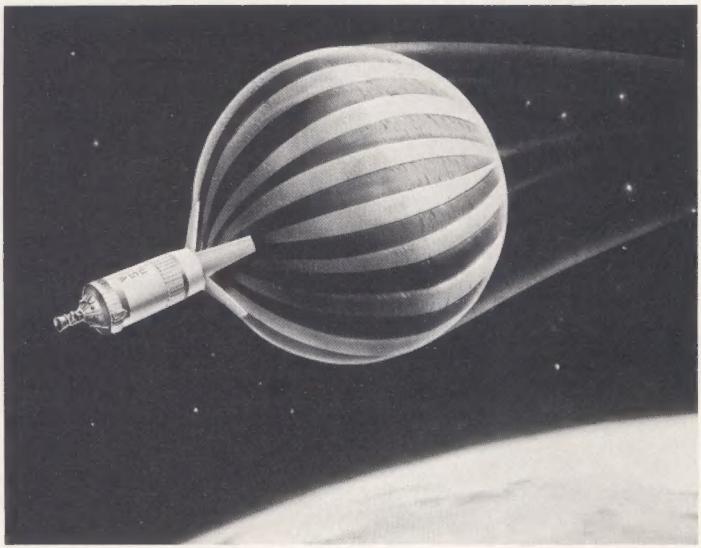
WANT TO BE A SUCCESS?
Here's what it takes

Elephants under the sea

WAS EINSTEIN WRONG?



THE HIGHWAY DEVICE THAT CAN SAVE YOUR LIFE



Junkman for space

SPACE engineers are thinking of putting plastic balloons in satellites and rockets (as shown in drawing above) in order to slow them down and get them out of orbit when their usefulness is finished. CODIS (Controlled Orbital Decay and Impact System), now being studied by AVCO's Space Systems Division is an instrument designed to get rid of orbiting junk now cluttering up space. Several hundred objects are now whirling around earth, but only a fraction of them still have a useful mission. Most are worn-out satellites and discarded rocket casings.

The heart of CODIS is an inflatable decelerator (balloon) that speeds up the natural rate of orbit decay. The decelerator is inflated by gas pressurized tanks to the diameter needed to deorbit the object from which it is deployed. On command from earth-based tracking stations, the decelerator will guide the fragments surviving reentry to a safe ocean landing.

In the future, it is hoped CODIS will be able to minimize the amount of space flotsam. AVCO has suggested that it be incorporated in all future Apollo (manned-satellite) applications experiments.

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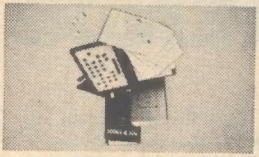

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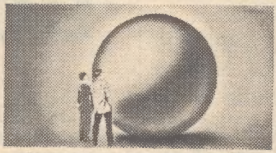

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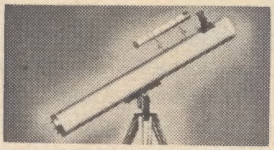

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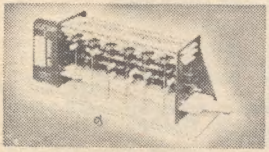

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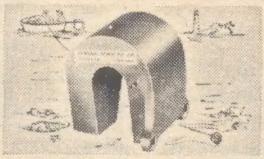

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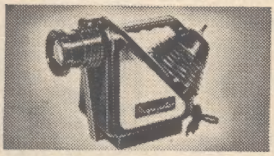

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MYSTERIES abound in the world around us—things for which science as yet has no answers.

What happened to the vanished civilizations—the people of Machu Pichu in the Andes; the builders of Angkor Wat in Cambodia? Why are West Coast oranges shrinking? Why are few elephant remains found—is there a graveyard?

New exploration continues to turn up brand new mysteries. One of

THIS MONTH

them: the strange dry valleys of Antarctica. On a continent buried beneath two miles of ice, these barren deserts in which no snow ever sticks, where glaciers peter out 20-30 miles from the sea, where open water lakes are cold on top and warm at the bottom, pose an anachronism that has geologists wandering through a maze of theories with no answers.

I had the privilege of seeing these valleys a few years ago; of observing the bodies of mummified seals —some of them 2,000 years old but still complete down to hair and eyes. When William Perkinson's article on these unique valleys appeared in the *Baltimore Sun,* it seemed like a good start for a new series of science mysteries which will appear as good subjects come along.

You'll find Mr. Perkinson's article on page 32; the first of a fascinating series. —THE EDITOR

news, knowledge, advice

SCIENCE

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DIGEST

In space and at the bottom of the sea man's endurance is being strained to its limit. Surprisingly man is turning out to be a lot tougher, physically and psychologically than he was given credit for. See the special report beginning on page 40.

Photo Fred Zimmerman, Pictorial Parade

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Bulletins at press time

VIRUS TRAP. A resin-like material may be used to filter harmful viruses out of drinking water. Viruses escape normal filtration treatments and such virus-caused diseases as infectious hepatitis have often been traced to contaminated water supplies. The development was announced by three scientists of the Monsanto Chemical Co.

OLDEST PRINTED TEXT. What is believed to be the oldest printed text yet discovered has been found in the stonework of a Korean temple. It is a Buddhist scroll some 20 feet long, printed from 12 wooden blocks carved with Chinese characters. The temple in which the scroll was found was built in 751 and the text was translated into Chinese in about 704, thus the text must have been printed sometime between those dates. The previous record was held by a one page Japanese document that was printed in 770.

MEDICAL TV. Dr. James L. Goddard, head of the U.S. Food and Drug Administration has proposed a unique method of getting up to the-minute medical information to doctors. He has advocated setting up a private, nationwide television network which would broadcast the advantages and disadvantages of newly developed treatments and drugs.

SHRINKING JUPITER? R. Smoluchowski a Princeton U. physicist has theorized that Jupiter may be slowly shrinking. This shrinkage, he thinks, may be the source of the tremendous amount of energy the giant planet gives off. This energy emission is equal to a 1000 megaton hydrogen bomb per second or about three times as much energy as it gets from the sun.

SOVIET CYBERNETICS. The Soviet Union originally rejected cybernetics as a, "reactionary pseudoscience which arose in the United States." Today, according to a study recently completed by the Battelle Memorial Institute, cybernetics is a household word and the government is making a great effort to integrate cybernetics with the beliefs and institutions of Soviet society. The Battelle report contends that the future of the USSR may depend on the way this integration is finally effected.

SPOTTING FETAL TROUBLE. An advanced technique for spotting fetal heart distress several hours before birth has been developed by a team of scientists from the Yale School of Medicine. It features a new device for continuous electronic monitoring of the fetal heart rate, together with biochemical tests of fetal blood samples. The system is intended to detect trouble in time to prevent death or irreversible damage to the baby's health.

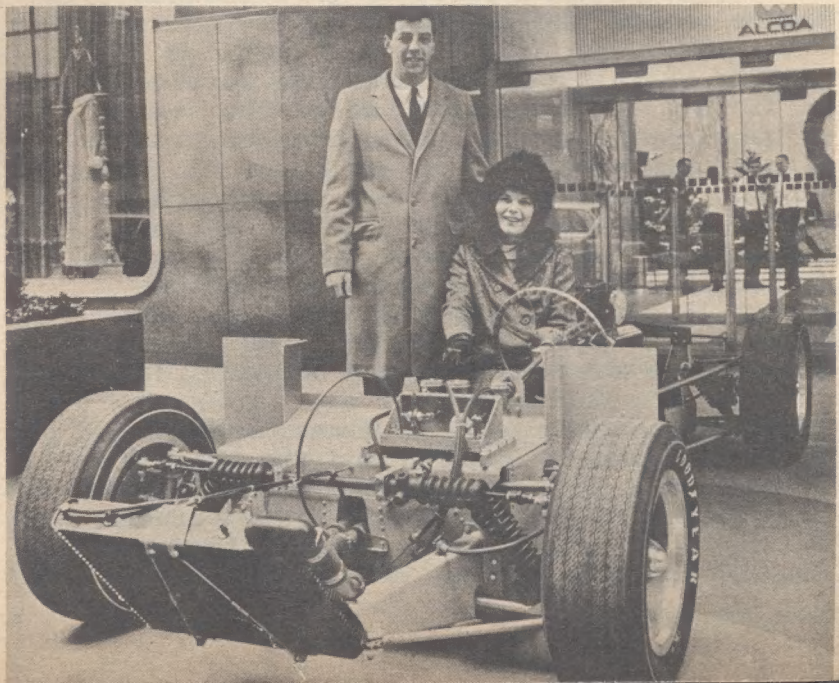
VIETNAM MENTAL ILLNESS. American servicemen in Vietnam are bearing up under the strain of battle better than their counterparts in either the Korean War or World War II. According to Medical World News neuropsychiatric problems are far down on the list of casualties, ranking eighth among the causes of hospitalization. Psychiatric problems affect 15 out of 1,000 fighting men. In Korea it was about 66 out of 1,000 and in W.W. II the rate was 101 men out of 1,000.

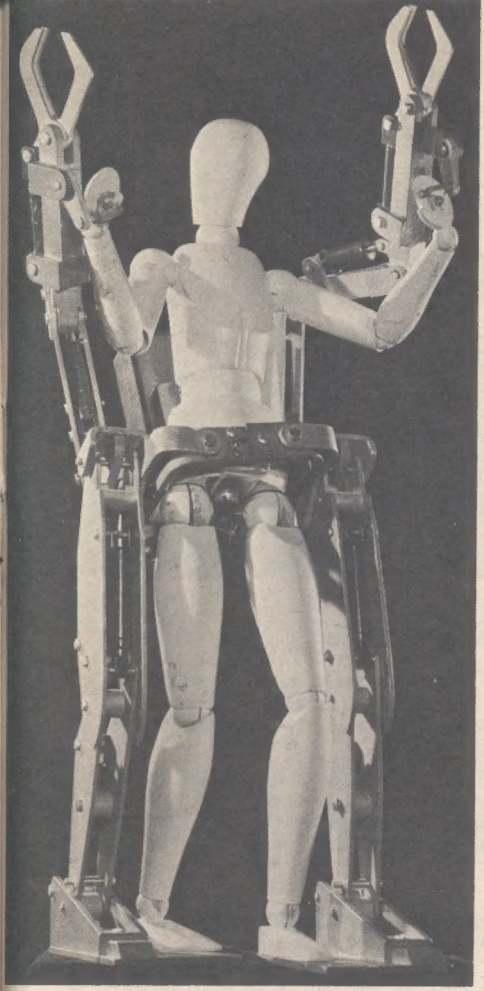
PERSISTENT WOMEN SMOKERS. Women find it harder to give up smoking and are more likely to return to the habit than men. This is the conclusion of a study of 1,000 persons who attended "Smokers Anonymous" clinics in the Chicago area during 1966.

Items in brief

Warm soles. Electrically heated innersoles are supposed to keep the outdoorsman's feet warm in the coldest weather. The soles, which work like tiny electric blankets are powered by a battery case attached to the belt. Available from Casey's Corner, P.O. Box 1280, Hollywood, Fla. 33022. . . . **Steel soles.** A new wrinkle in golf shoe manufacture is that the spikes are being screwed into a stainless steel spike plate rather than a leather sole. . . . **Only his barber knew for sure.** For years, a few men such as actors, have dyed their hair, but usually in privacy. Now there are many home preparations for men who feel they must meet job competition from those who look younger.

Single dashboard control replaces wheel, accelerator and brake. Developed by R. L. Cosgriff of Ohio State U., unit is first step toward computer-controlled vehicle that will drive itself without help. **All aluminum** chassis, transaxle, radiator, wheels (to name a few components), plus fiberglas body. put Chevy's new Mach I sports car out front in advance design. Its 425 engine produces about 185 mph.



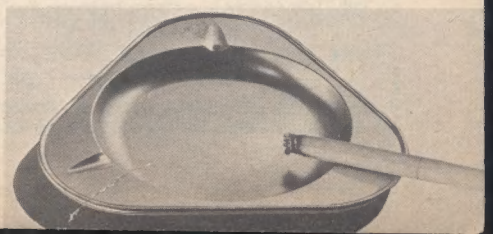


Mechanical muscles of GE's new "powered exoskeleton" will enable a man to lift, carry and climb with a 1500 lb. load. It can be worn like a suit. The Army has ordered it.

Flexible glass, chemically strengthened, was first made by Corning Glass for the windows of Apollo's lunar module. You'll soon see it in new auto windows and trains.

Better flashbulbs, with more consistent and uniform light are on the way. They are made of shredded zirconium foil and will be produced by Westinghouse.

Foil ash trays that you can throw away after the party are the result of new metallurgical research in aluminum alloys. The trays are sturdy, cheap and disposable.



Is This The Answer To Einstein's Quest For A Unified Field Theory?

Einstein spent his later years in searching for an all-encompassing theory that would include his Theory of General Relativity and his Theory of Special Relativity, a theory that would link the phenomena of Gravity, Magnetism and Electrostatics into one indisputable general law.

A solution to Einstein's quest is offered in a provocative, interesting 64 page book, "Unification of the Fields of Gravity, Magnetism and Electrostatics Using a Law of Relative Motion," in which the author traces the search for a common law from its origins with Galileo, through the initial calculation of the speed of light by Roemer, the famous Michelson-Morley experiment and on to Einstein's almost successful search to unravel the mysteries of the Universe. The book is written in a clear, concise, lucid style and will prove to be absorbing reading to the scientifically trained mind and to the layman alike. It will enable the reader to gain a clearer understanding of Relativity and of the Universe in which we live.

The book opens new avenues of thought about the basic laws that govern the Universe—suggests new applications of known phenomena—and lays to rest the antiquated understructure of much of today's concepts concerning the components of our Universe. Phenomena such as quasars, "red shift," mass and time are examined from a new point of view.

To physicists and others of the scientific community the book offers the challenge of a provocative, new theory worthy of the most probing analysis. To the layman interested in modern trends of scientific thought the book will be a fascinating adventure to the frontiers of science. The limited special edition is now available at only $1 per copy, mailed postpaid.

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Computers, like the one employed by a shock-research unit (above) are already a part of medical research, and in the near future they will come into everyday medical use.

Instant medicine by electronic brain

by Kenneth N. Anderson

A car headed west on the Ohio Turnpike begins to pass another on the rain-slicked paving outside of Cleveland, but the driver suddenly collapses. The car veers off the road to the left and rolls over in the divider strip. When the police arrive, they know only that the car has New York license plates and the injured driver is unconscious and bleeding.

This kind of accident could occur today; it's happened many times on many highways. What makes this accident different is that the driver is wearing a medic-alert bracelet with a series of letters and numbers beneath his name. One of the officers radios a hospital and reads the information to an attendant who reaches for a telephone dial on a nearby console and feeds the information into a circuit.

A second officer aims a portable television camera toward the accident victim, then zooms in on a part of the face at the request of a doctor who is studying the condition of the driver on a TV monitor in the

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emergency ward of the hospital.

An ambulance helicopter lands in the median strip. An electronic sphygmomanometer is placed on the victim's arm to get blood pressure; other portable diagnostic devices are ready if needed. Within minutes after the first police call, the driver is airborne, and before the helicopter lands on the hospital roof the doctors on duty probably will know more about the victim than the average doctor today knows about his own patients.

This is not just a dream of the future. Every aspect of such emergency medical care is available today and is gradually being adopted by government and private hospitals. The code on the medic-alert bracelet, for example, is the key to the patient's complete medical history, stored in a memory unit of a computer data center. By dialing the data bank, a teletypewriter in the hospital—eventually any hospital—will print out everything known about the patient from his childhood diseases to his latest electrocardiogram and blood chemistry.

The portable TV camera designed to help highway accident victims already has been used by French police, permitting a physician far from the scene to view the condition of the patient on a screen so the doctor can advise emergency treatment or supervise by remote control the careful removal of the patient. Portable electronic instruments to monitor blood pressure, heart rate, and other physiological factors have evolved from aerospace medical research. The helicopter ambulance has become well established as a fast way of evacuating patients in Vietnam.

The use of computerized diagnostic and record units and medical monitoring systems is well beyond the dream stage. The University of Missouri Medical Center, for example, has in service a complex of an IBM 1410 computer and IBM 1092 data transmission terminals which:

- evaluates laboratory tests for accuracy and content;
- automatically reports the results of tests to the nurse's station of the patient's floor;
- stores in an electronic memory all information contained in the tests;
- has the capability of making any part of the accumulated data instantly available for statistical, diagnostic or research purposes.

The Mayo Clinic at Rochester, Minn., is establishing a computer system that will record details of a patient's medical history, lab tests and other information from the hour the patient checks in, following him through the clinic examination and treatment, and even sending reports back to his family physician after he leaves.

New York University has received a $2,300,000 grant from the Department of Health, Education and Welfare to establish in 1967 a patient data bank. The initial cataloging of health information will be concentrated in the Pediatric Dept. of the Bellevue Hospital Center in Manhattan. Later, it will be ex-

Left: Children's heart ailments have been detected by recordings of surface electric voltage on body. Center: Radioisotope data recorded on magnetic tape by radiation scanner. Right: Leg bones replica can record knee motion for processing by computer.

panded to include other children in the New York area. Eventually, the data bank will catalog medical details of both children and adults through much, if not all, of the United States, according to present plans. And the information about a patient will be available to any authorized doctor in the nation who dials a long distance number and provides the identifying code for the patient.

Once the data bank has received information about a patient's childhood diseases, blood chemistry, and so on, it will be immediately available in the event the person is, for example, stricken by a heart attack, or appendicitis, while hundreds of miles from his home base. Any hospital equipped with the computer-readout equipment could dial into the data bank.

According to Edwin Kraus, director of computer systems for the N.Y.U. Medical Center, the gobbledygook of computer language will be eliminated from the data bank. A new system, called Narrative Data Analysis programming, will be used—meaning that medical information will be recorded in complete sentences of the English language.

Besides being able to call up an accurate, readable written record of a patient within a very few minutes, there are other benefits. One is that the doctor is relieved of the time-consuming chore of record keeping. By turning over to the computer the record-keeping chores, the medical personnel have more time to take care of the patient.

Another benefit is that diagnosis of diseases, as well as the most favorable kinds of treatment, can be enhanced by organization of information about ailments. With hundreds of thousands of cases of a disease recorded in a data bank, medical researchers can learn more about the disease by having the computer analyze signs and symptoms. For example, exactly what

Computer evaluation of the records of 400 kidney patients found four different kidney diseases instead of one.

constitutes bronchial pneumonia? What sort of track record does penicillin have in treating the disease? At the present time, a doctor may see but a few cases each year and may have to depend upon his memory in making a diagnosis.

But a computer can sift out details of every case reported in the past year, or past decade, and forecast the outcome of the various types of treatment available.

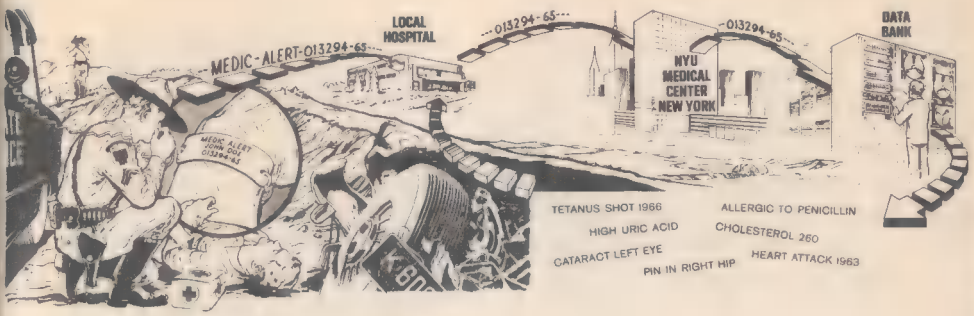
However, computers, like humans, can make mistakes. The physician must make the final decision, and accept the computer as a usually reliable expert consultant. Dr. Frederick Schwartz of the American Medical Assn's Council on Aging recently described a goof made by a computer that prescribed high carbohydrate meals for a group of patients who tested positive for diabetes. The patients were eating the wrong foods for three days before the error was discovered.

On the other hand, the Rand Corp. of Santa Monica, Calif., staged a blind competition between a computer and a team of physicians and chemists working on the same problems in a surgical laboratory at the University of California. Although there were a number of "discrepancies" in the results of more than a thousand analyses of human blood, in no instance was the computer wrong.

Computers, of course, do not digest any and all information fed into them. The information must be presented in a precise and systematic way. And the computer must be told what to do with the information. But it can be instructed to work within certain limits of data and to reject abnormal or unusual bits of information it finds while sifting through a myriad of medical records. And it can be programmed to print out the reason for rejecting a piece of data.

Confusing symptoms

In the area of kidney diseases, an IBM 7090, analyzing facts from cases of 400 patients with pyelonephritis, revealed that doctors have been dealing with four different diseases instead of one. The disease, a bacterial infection of the kidney, had confused doctors for years because the symptoms would come and go, some patients had pain while others felt no pain, and evidence of the disease was found in autopsies performed on persons who appeared to have died of other causes. The revealing study was made at Columbia-Presbyterian Medical Center in New York by using the computer to sort through some 32,000 items of information about pyelonephritis. Without computers, it is doubtful that medical scientists would have been able to solve the kidney disease riddle.



State police radio name and number on accident victim's medic-alert bracelet to nearest hospital. Medical data can be processed and doctor can monitor patient's condition.

At the Mayo Clinic, an IBM 7040 computer is used to locate tumors and cancerous tissue in body organs, capturing and improving the data obtained from radioisotope scanners just as a computer is used to improve pictures of the moon received from space probes. The patient receives a dose of medicine containing a mildly radioactive tracer which is absorbed more readily by malignant tissue cells than normal cells. The body area is then scanned by a radiation detector and the data is recorded directly on magnetic tape for computer processing. The radiation is measured every tenth of a second and the location of the reading is recorded.

According to Dr. W. Newlon Tauxe, the Mayo radiologists can see "many more things on a computer-processed scan than we can on a film record." Besides improving the clarity of the image, the computer can be programmed to compensate for the rapid decay rate of isotopes that doctors prefer to use because they produce a high level of radiation for a brief time and are less dangerous to the patient. Also, the computer is able to eliminate false zero readings, correct for ragged edges in the picture, eliminate background "noise" of natural radiation, and can plot paths of equal radiation, much like the lines on a contour map.

The University of Missouri Medical Center performs a half-million laboratory tests each year and the computer system relieves the lab personnel of a tremendous amount of detail work, while at the same time it helps to concentrate medical care where it is most needed. The computer evaluates newly completed tests to include such factors as age, race, sex, previous patient diagnosis, relation of new test results to earlier ones, accepted normal range of values, relation to results of similar tests at the medical center, and biological properties of bacteria and antibiotics.

The computer's memory already contains records of all patients handled by the hospital since 1955, data on 50,000 tissue specimens in a surgical pathology file, a tumor reg-

istration file of all patients treated for abnormal tissue growths, a file of physicians' interpretations of all X-rays taken there since 1955, a file of 60,000 electrocardiograms coded by 105 categories and a computerized version of the American Medical Assn's *Current Medical Terminology,* an encyclopedia of diseases by disease symptoms, origins, etc.

Several hospitals, including Massachusetts General, Long Beach Memorial and New Jersey's Monmouth Medical Center, are starting computerized drug-ordering systems. At Massachusetts General, the doctor's orders for medications are fed into the computer by writing them out on a teletypewriter terminal.

At Duke University, a computer was used recently to solve the medical problem of a single child. The tot had the symptoms of severe heart trouble but a more conclusive diagnosis was needed before surgery could be undertaken to save its life. A computer was fed taped recordings of 250 electrocardiograms taken from all parts of the child's body. Within 20 minutes the computer had analyzed the EKGs and produced a contour map which showed the electrical function of the heart.

In one area, it showed, there was no electrical current being generated by the contraction of heart muscle. It was the lower part of the left side of the heart. An opaque liquid was injected into the heart through a blood vessel leading to that organ and an X ray was taken. The study showed that one of the arteries supplying blood to the heart was on the wrong side. Knowing exactly where to go, the doctors corrected the defect by surgery.

19 Astronauts: 75¢

And it's a bargain at the price. This limited edition lithograph entitled "Our First 19 in Space" has been created as a tribute to America's gallant astronauts. Printed on heavy weight paper, suitable for framing, this 12 x 18 inch reproduction is both educational and decorative. It can be hung in children's room, den, library or just anywhere around your home.

To order your copy of this limited edition lithograph, send 75 cents plus 10 cents postage in cash, check or money order to:

POPULAR MECHANICS,
ASTRONAUT PICTURES,
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New York, New York 10022

I have enclosed $_____ plus 10 cents postage for _____ copies of Popular Mechanics Astronaut Picture.

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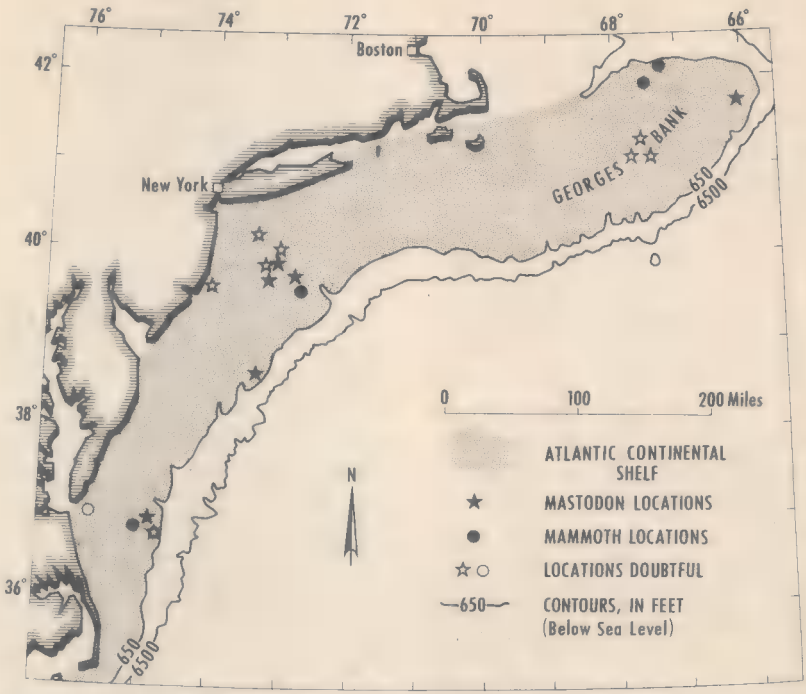


Map of the 316,200 mile-long Continental Shelf pinpoints locations of Ice Age elephant fossil deposits, consisting mostly of bones and teeth of mammoths and mastodons.

Elephants under the sea

A large population of Ice Age elephants—mastodons and mammoths—roamed on what is now the submerged Atlantic Continental Shelf from 25,000 to 11,000 years ago.

An increasing number of fossil bones— particularly teeth—of elephants are being discovered as the result of continuing sea bottom samplings off the East Coast by scientists of the U.S. Geological Survey and the Woods Hole Oceanographic Institution.

The two agencies have been teamed up in a 5-year project, started in 1962, to make a comprehensive geologic study of the 316,200 mile shelf. The project is, primarily, a search for deposits of minerals and other valuable resources.

"Discoveries of elephant teeth, as well as other kinds of Ice Age bones," says Dr. Frank C. Whit-

more, paleontologist of the Geological survey, "have become an especially interesting 'by-product' of the shelf survey; they're providing new knowledge of offshore conditions that existed in the past.

"Repeatedly," says the scientist, "fossil bones are picked up by fishing vessels, quite by accident, as the result of trawling and dragging operations. Often, the strange objects are tossed overboard; sometimes they find a 'home' on a fisherman's mantlepiece; but sometimes they wind up in a scientist's lab where they become a welcome addition to a collection of fossils that may help unravel the history of the sea."

During the Shelf project, systematic sampling (every 10 miles) soon yielded a large number of fossils. Says Dr. Whitmore, "teeth have been found 80 miles off shore, in water as deep as 270 feet, and we have come to the conclusion that there was a large elephant population extending to the very edge of what is now the Continental Shelf."

"Elephant teeth are common on the sea bottom," the scientist explained, "not only because there were lots of elephants, but also because the teeth are large and sturdy and can resist the effects of erosion and decay."

Dr. Whitmore said that "of the two types of Ice Age elephants, the mastodon is identical with the specimans that have been found many places on the U.S. mainland. The mammoth, however, is somewhat different from mainland forms; its tooth pattern bears some resemblance to the famous woolly mammoth which has been found frozen in Alaska and Siberia. We believe that the Shelf mammoth may have lived on sub-arctic vegetation such as spruce and fir needles."

Dr. Frank C. Whitmore, Jr., (left) vertebrate paleontologist of the U.S. Geological Survey measures fossil tooth of Ice Age mammoth dredged from 100 feet of water off coast of Virginia. Tooth in front found in Ill. (artist's conception of beast, right).

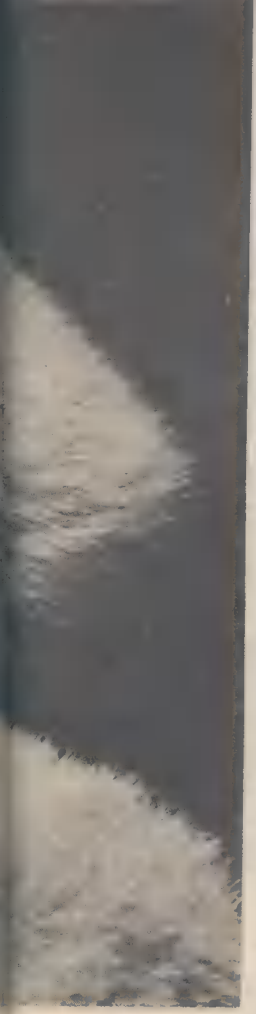
Photos by Stan Federman

Lemur: Low man on the primate totem pole

ABOUT 75 million years ago, creatures strangely similar to the black lemurs (left) were swinging through the trees. The prosimian order to which the lemur belongs is the oldest and most primitive on the primate totem pole. Though they look like fur-ruffed dogs with a thyroid condition and most species are gentle, adorable and not terribly bright, prosimians are our ancestors and have managed to survive these many millenia. One reason for their longevity is that they moved to isolated regions (lemur to Madagascar, loris to what is now Ceylon and Malaya, tarsier to the Philippines, et al) where they could flourish undisturbed. The other reason for their survival is an opposable thumb and forefinger and stereoscopic vision, two characteristics that gave primates the edge over other animals. The biological makeup and behavior patterns of prosimians may reveal clues about our own. That study is the work of 50 scientists at the Oregon Regional Primate Research Center.

The nocturnal loris is one of the most vicious prosimians, especially when roused in daytime. Handlers don't take chances and always wear gloves.

Five-year-old fulvus lemurs were born in captivity. Reproducing and keeping prosimians is difficult but these grew up to be healthy and lively.



Quick-footed fulvus lemurs can be tamed more easily than most other prosimians and often become the keepers' pets. When fondled, they make purring noises that sound like a contented cat.

Ringtailed lemurs are the clowns of the group, often singing in chorus for morning reveille. Left bot., baby ringtail rides mother's back. Clow loris (r.b.) shows its natural caught-in-the-act look.

Ringtail above looks like a cross between spotted koala bear and scared racoon.

Baby galago (Africa) perching on man's finger has batlike ears and manlike fingers.

Tarsier, one of world's rarest and shiest animals, is hard to keep in captivity.

Suckling potto baby has furred tail and ginger color common to several species.

New World howler monkey is one of many higher primates being studied at Center.

The New Yorker

Battle of the sexes

by Flora Rheta Schreiber and Melvin Herman

"MEN," said Dr. Richard E. Farson, director, Western Behavioral Sciences Institute, at a recent ladies' magazine seminar, "are losing self-esteem, and their very self-worth as males is in jeopardy."

This derogation is attributed by some to automation and its direct conflict with the "puritan ethic." Other factors presented by believers in the "downfall of man" are the paradoxes created by the "electronic revolution" that has presumably deprived men of activities in which physical strength and stamina are important.

As the male side of the seesaw bends adversely, according to this school, the female side gains strength. The reasoning: since women are generally less encumbered by the puritan ethic than are men, and less dependent for feelings of self-worth upon "bringing home the bacon," the same social forces militating against men are acting in favor of women.

On the face of it, certainly, there appears to be some logic in the case. For women, the machine's usurpation of everyday pursuits is

Miss Schreiber is an award-winning writer on psychiatry; Herman, the Executive Secretary of the National Association of Private Psychiatric hospitals.

more acceptable than for men. Skills usually associated with women may well be sought after in the rising activities of the future—health, education, welfare, recreation. The feminine touch may be more and more in demand, too, in a future that will find us crowded together more than in the past. Physical proximity brings emotional distance and an increasing superficiality in human relations. To counteract this, women will fall heir to the task of facilitating and easing human, person-to-person contacts.

A climate that favors women can result in their dominance, and history indicates that most women don't enjoy being dominant. Single girls report that they want a dominant male. Unfortunately, many women are forced into a matriarchal role (sometimes to pathological proportions) from lack of a strong male. Unfortunately, too, the absence of a dominant male appears to be a decisive ingredient in the recipe for homosexuality and other aberrations in the offspring.

In such family constellations, men feel unseated; women defeminized. Both sexes realize, however dimly, that in a sense they don't need each other anymore. There are no bandits to fight, no log cabins to be built and the man can get by without a woman to clean house. "We used to love each other because we needed each other," says Dr. Farson. "Now it is turned around. We need each other because we love each other. So the bonds are no longer functional, but affectional."

Dr. Farson's contention, if true, can certainly have positive aspects. Affection certainly seems a more salutary basis for a human relationship, marital or otherwise, than the mere fulfillment of service drives.

Marriage, however, seems here to stay. Paradoxically, as women become more career-minded, they also become more marriage-minded. Both careers and marriage are increasing in percentage. Forty percent of married women over 40 are working. Women are rushing into marriage, even when they plan careers, at increasingly early ages.

The quality of sexual experience, especially among educated women, has improved. The frequency, however, has decreased. All the evidence since Kinsey points to female sexuality being equal to, possibly stronger than, male sexuality.

Yet all is not sweetness and light for the "new" woman. There is a great discrepancy between "legal rights" and actual rights as perceived by both men and women. The more improvements in her life, the more discontented the lady becomes, for with improvements come higher expectations, new opportunities, new involvements, higher-order needs to be satisfied. History of revolutions shows that they come after reforms and improvements have been made. This means, for example, that the rising divorce rate doesn't necessarily reflect poorer marriages, but possibly that improvements have brought higher ex-

pectations and more discontent. Ironically, it is the improvement which may be creating the divorce.

There are no easy answers. The hope is, however, that out of the ferment will come a greater self-realization for women at the time that men rediscover themselves.

You can make yourself sick

Good family doctors have to be wizards. Often, very real symptoms they see can be diagnosed easily, then fail to respond to anything. The good ones know why. It's why placebos were invented, why Lydia Pinkham's "pink pills for pale people" grossed millions, and why old fashioned family doctors acquired reputations for being father, mother, pillar of strength and, finally, physician extraordinaire. Basically they were sound psychologists. They *knew* their patients. Today, few family doctors have time to explore the psyche of every patient and prescribe accordingly. But some take the time to apply insight when they're suspicious.

One recent case history will do. The patient was a young woman. Her symptoms: Fatigue, loss of appetite, sleeplessness and (obviously to the doctor) anxiety. He'd noticed her crossed leg swinging and her nervous fingers plucking at her dress. He quickly ascertained that the condition was two years old; also that she'd been married two years.

"Your marriage is a disappointment, isn't it?" he asked. The seemingly irrelevant question opened the floodgates and the doctor got an ear full, as he knew he would. It was a transparent story. As a suitor, her man had been Prince Charming, kind and considerate. Now he was a callous, indifferent boor—"Just like daddy was to m o t h e r." The d o c t o r promptly recommended a psychiatrist. He wasn't about to waste a lot of expensive hours and drugs on symptoms (real enough) rooted in garbled emotions.

This little anecdote, from the annals of Dr. Rex W. Speers, assistant professor of psychiatry, University of North Carolina School of Medicine, emphasizes the fact that while there may be organic reasons for the loss of appetite, sleeplessness and anxiety, it is unhappily possible for a tricky mind to create all sorts of genuine physical disorders if it is upset enough. Usually, the victim thinks he has a medical problem for which he naturally seeks medical or surgical treatment. Who wants to blame himself? "The basic pathology in cases like this one, however," as Dr. Speers puts it, "is the interaction of the patient and his spouse. The interaction is the marriage."

Such "interaction" may be the result of personality difficulties in the patient, or in the spouse. Difficulties in the patient may be psychotic, neurotic, characterological—

Marriage conflicts are often triggered by two "normal" people interacting neurotically under certain conditions.

or it may even be a real organic disease producing the personality disturbance. It takes an expert to tell. Difficulties may lie in the spouse rather than the patient. Or there may be two "normal" personalities interacting in a neurotic or psychotic manner under a particular set of circumstances that will trigger abnormal behavior. Whatever the manifestation, the truth is that when symptoms are rooted in marital interaction, a doctor's usual arsenal of detection—the KG, the X-ray, the complete laboratory and the stethescope—is useless.

The wise, perceptive doctor will refer the patient to family counselors or to a psychiatrist. But it is even possible for an intelligent patient to have the courage to look at himself (or herself) and *know* that pills won't do the trick. In marriage—the closest human arrangement we have— there's nothing to be ashamed of. It's tough.

Dr. C. Nash Herndon, professor of preventive medicine and genetics, Bowman Gray School of Medicine, North Carolina, maintains that "Optimum health must include adequate adjustment of the individual to family life, and marriage counseling must certainly have a place in such a program."

"Marriage," says Dr. Herndon "is a great institution. No family should be without it. However, it is also a two-edged sword. On the one hand, it can be a source of the deepest personal satisfaction and inspiration. . . . in a frenzied world where standards of lasting value are hard to find. On the other hand, an unsuccessful marriage can initiate a surprisingly long and complex series of reactions and interactions, with a wide range of social, psychologic and psychosomatic effects on the couple, their children and even the innocent bystander.

"Too many physicians," says Dr. Herndon, "remain blissfully unaware of the marital problems of their patients until called upon to sew up the lacerations resulting from personal combat."

Back To Baby Farming?

"Today's society needs a new attitude toward what is best for mother and children." That's the word from Dr. Bruno Bettelheim, professor of psychology and psychiatry, University of Chicago. The mother, Dr. Bettelheim told a recent audience, often overextends herself in her eagerness to give *up* to the child at the same time that she gives *to* him. This results in the mother expecting too much from herself, whereas a professional caretaker would know better than to spend more resources than she has.

The mother's role is highly-charged and inflammatory. The

very fact that she is the most important person in her child's life makes him anxious. When someone less important in his scheme of things reprimands him, he is less frightened than when she does. Mother's admonitions are more intensely resented than similar injunctions from another person, whether a relative or a stranger.

Depressed mothers

Depressed mothers are often the rule, not the exception. Mother's spirits sag when she finds she no longer has a moment to herself. In spite of herself she becomes bored with the child even though she wants nothing more than to be happy with him and to be a loving, responsive mother. The child suffers during this period because just when he has the most urgent need for an emotional give-and-take, the "giver" is too emotionally spent to deliver.

To offset this anxiety-ridden mother-child relationship, Dr. Bettelheim proposes professional help for mother. "If the mother," he says, "had someone professionally trained to administer do's and dont's, someone not emotionally tied to the child nor the child to her, both mother and child would gain immeasurably." In such a setup the rejection of a child's demands would not lead to emotional uproar for either the mother or the child.

The Bettelheim contention is that: 1. The professional worker is protected from the emotional hazards which the mother experiences since, being an outsider, the professional is assured of predictable relief after hours; 2. The professional has the companionship and stimulation of other adults at work and still has a life of her own after working hours.

Mothers, of course, out of sentiment and duty, may resist such arrangements but, as Dr. Bettelheim puts it, "they must be convinced that such arrangements are best for both mothers and children. The time the mother relieved of double-duty can spend with her child will therefore provide more mutual pleasure and growth."

Working mothers

A special point is made about working mothers. Employers are enjoined to make necessary arrangements so that mothers should not come home from work so tired that they cannot "give" to their children. This requires shorter working days for mothers and flexibility of working hours so that in emergencies when the child needs his mother, she can absent herself from her work. Such a mother, it is postulated, will do a better day's work, since she will not feel that she is cheating her child.

In summary, Dr. Bettelheim asserts that "a much more rational attitude about what is best for the child and what is best for the mother is necessary in our world of today, which is so different from the world of previous times."

Idea of the month:

Power from a bottled thunderstorm

Marks brothers Mortimer (L) and Alvin examine "power bottle" invented by Alvin.

MAKE-IT-YOURSELF electricity for the average home may soon be practical.

A machine that uses a charged aerosol to turn heat directly into electricity promises to make the conventional turbo gas electric generator obsolete, according to its inventor. He compares his curious device to bottling a thunderstorm. Gas and minute droplets of water whirl around, flywheel fashion, inside a steel doughnut, but there are no moving parts.

The gas, usually helium, is sprayed with hot water, which an electric charge breaks into the fine droplets. The heat and kinetic energy (from the motion) generate additional electricity, which is collected on a grid and drawn off.

The Navy thought enough of the idea to support its development with more than $600,000 in contracts.

Alvin M. Marks, "father" of the idea, and *Science Digest* Inventor of the Month, is president of Marks Polarized Corporation, Whitestone, L.I. He was a member of President Kennedy's power panel in 1963, and prepared a "state of the art" paper on his generator for the Office of Science and Technology. Mr. Marks recently was granted Patent 3,297,887 for his transducer.

The heat source in a large plant using his principle may be conventional or nuclear. On a small scale, the inventor estimates, an aerosol generator the size of a grapefruit, drawing surplus heat from the home furnace, would provide all the power required for an average-size house.

No government use has yet been made of the aerosol generator, although the Air Force is conducting its own research. The Marks company, which owns the commercial rights, has recently licensed the Nordson Corporation of Amherst, Ohio, to incorporate the machine into equipment that applies coating materials electrostatically.

—Stacy V. Jones

Little bang

A powder charge the size of an aspirin that generates enough energy when exploded to drive fasteners into concrete may one day provide the energy source for lawn mowers, outboard engines, and light aircraft engines.

The USM Fastener Company, division of United Shoe Machinery Corp., has taken a nitrocellulose mixture and formed it into a pellet called the AMMO "Power Cap." After the power pill is dropped into the chamber of a specially-designed hand-tool, the trigger is pulled and energy is released, driving or riveting at a controlled velocity.

There are no leftover ejectors or spent shells since the pill is completely consumed when it is exploded.

Because the pill burns instead of exploding if ignited outside the tool chamber, it's safer to handle, transport and store than powder cartridges. The pill charge needs no expensive metal case or specified amounts of wadding, primer and powder, so production costs are considerably less than for the ordinary case charge.

The little nut-shaped object the girl is holding in her fingers is AMMO Power Cap, possible energy source for aircraft.

With this new caseless charge, it will be practical to use powder-actuated tools more extensively in construction, electrical, air-conditioning and similar industries than was possible before.

Liquid-cooled suit

Not every device used in the space program is out of this world. A liquid-cooled suit test-worn by the Apollo astronauts is now ready-to-wear here on earth.

Manufactured by B. Welson & Co., the Cool Suit is a light-weight vest that is comfortably worn under regular clothing and is very easy to work in. It will be especial-

ly useful to workers in foundries, heat treating rooms, specialized laboratories and other facilities where the temperatures are high and air-conditioning isn't feasible. The garment, however, isn't quite mobile enough yet to wear to work on a sweltering summer day.

In order for the liquid-cooling system to work, a controllable, steady flow of water is needed to circulate water through the suit. The water flows through closely spaced network of miniature flexible tubing woven into the elastic fabric. Any handy cold water pipe can be tapped as a source.

Heat generated from the body and heat from the environment is conducted to the lower temperature water circulating in the tubing which is in contact with the skin. After flowing through 150 feet of tubing, the water is expelled through a hose into a drain.

The suit has withstood continuous exposure to 125° temperatures in an instrument lab, while race car drivers and test pilots wearing the Cool Suit have comfortably endured grueling 140° temperatures.

The vest is well suited to commercial, laboratory and industrial uses where there is a convenient water supply and drainage facilities are accessible.

Collapsible window

Back window of this convertible is actually constructed of collapsible glass instead of not-very-durable plastic customarily used in this kind of car. It's hinged to fold with car roof and won't discolor or scratch.

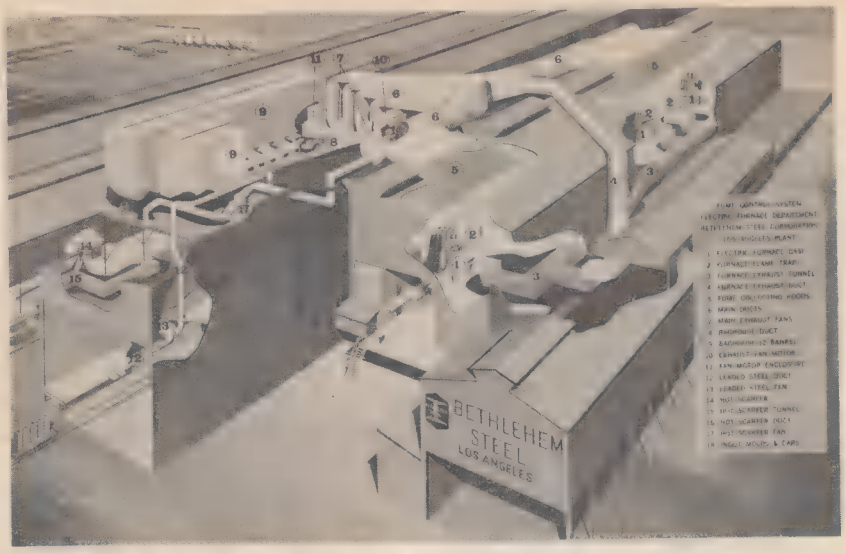
A collapsible window made of glass instead of semi-opaque plastic is now being used as the backlight of a convertible.

Developed by Corning Glass Works, the window is chemically strengthened and only 0.085-inch thick, one third thinner, but five times stronger than regulation auto annealed glass.

The tempered glass has been used in convertible backlights before (in 1964 Ford Galaxies and Mercuries) but this version of the back window is hinged, the two halves fused by a silicon-rubber strip to permit the piece to fit the window outline snugly as the top folds.

Should the glass break from heavy impact, it dices into small, harmless shards.

Fourteen inches high and 42 inches wide, the window is optional on 1967 Mustang convertibles.



Artist's rendering of baghouse pollution control system shows by numbers the exact layout of the smoke mop-up procedures. List at right of picture describes each part.

Air vacuum cleaner

A baghouse pollution control system that sucks dirt from the air much the same way a vacuum cleaner makes a clean sweep of the floor has proved nearly 100 percent effective in scouring emissions that come from steelmaking procedures.

The new $2 million system installed at the Bethlehem Steel Corp. plant in Los Angeles was designed specifically with hot metal industries in mind. The baghouse now ventilates their three million-cubic-foot electric furnace building on a full time basis and collects more than 125 tons of particles a week from the smoke generated in various processes.

Smoke is released at different times: at loading time; during melting operations in three electric arc furnaces; while tapping molten steel into huge ladles to be poured into ingot molds. As the smoke is discharged, it's captured in one of the baghouse hoods towering above each furnace. The building roof is a catchall for smoke escaping the hoods, which have bypass slots to recapture the excess smoke. Remote control dampers shift the exhaust according to the amount of smoke generated at any given time.

Two exhaust fans draw the smoke through 14-foot diameter ducts and discharge the smoke into a distribution manifold, where it is diverted into 27 individual sections of the baghouse. Each section is composed of 120 silicone-treated glass fiber bags that can withstand temperatures as high as 500° F.

To clean the bags, a reverse flow

of air collapses them, spewing the particles of dirt (some are submicroscopic) into hoppers lodged at the bottom of the dust collector.

Smoke collecting equipment formerly used to control emissions and building ventilation monitors have been incorporated into the baghouse system.

25c holograms

Though the baby science of holography has not quite reached the stage of homemade holograms, it is now possible to produce a master hologram that can be copied a thousand times at 25 cents each and can be reconstructed with ordinary white light—a candle or even moonlight.

Holography is the science of using a laser beam to record full three dimensional images on photographic film or plates. The exact images are reconstructed by shining a light through the film. (See *Science Digest*, Sept. '66).

Developed by Bausch & Lomb, the holograms are made by a split beam of coherent light from a simple gas laser. Both halves of the beam go through a photographic film and are reflected to the film from both a mirror and the image subject. Interference of the two reflected beams in the film emulsion creates the holographic image. The company markets the whole production kit for educational use at $750, which includes an instruction course.

A filter, preferably the narrow band pass variety but dyed acetate will do, placed between the light source and the hologram increases the sharpness.

Diazo materials, which are low in cost and high in resolution (400 lines per millimeter), are the reason that a hologram can be copied cheaply and easily. Because the diazo materials are sensitive only to ultra violet light, they provide the greater resolution of the shorter wavelengths, which is suitable for reproducing copies. Copies of the master can be made through the fourth generation without apparent loss of detail.

These 3-D images can be used for exhibits, advertising displays and school laboratory demonstrations.

Chewable "toothbrush"

A device that looks like a foam-rubber pacifier is really a simple but effective "toothbrush."

Devised by Dr. Myron F. Levenson, clinical pedondontist at Babies and Childrens Hospital of University Medical Center in Cleveland, the foam rubber chew stick is mounted on a curved frame that conforms to the structure of the mouth. Toothpaste is squeezed into the hollow of the stick, and as the teeth sink into and chew the rubber, the stick moves up and down, scrubbing the teeth and gums.

Inspired by similar sticks used in the dental hygiene of more primitive societies, the chew stick is designed especially to help handicapped children who do not have the manual dexterity to manipulate a toothbrush.

A SCIENCE MYSTERY

Puzzle of Antarctica's desert valleys

Bleak, desolate, frigid, cluttered with 1,000-year-old seal mummies and eerie, wind-sculptured rock, they fringe McMurdo's shore, defying explanation

by William J. Perkinson

MAN'S efforts to explore the moon and other planets together with what seems to be a world-wide fluctuation in climate have stirred new interest in one of the stranger areas of Antarctica, the ice-covered continent that surrounds the South Pole.

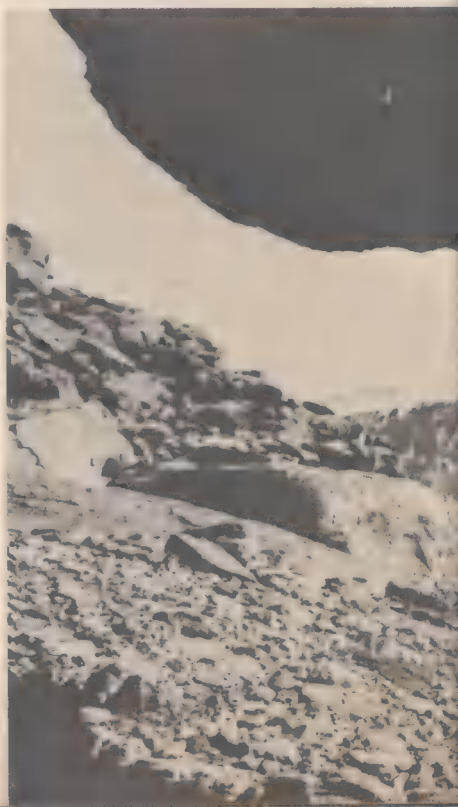
The area is called the McMurdo Oasis. It consists of several thousand square miles of dry valleys, so called because they are made of bare rocks that remain free of snow during both the summer and winter.

Still more curious, many of the isolated valleys contain lakes that are covered with 6-to-12 feet of ice during all but the summer months.

Yet scientists who have measured the temperatures of the water at the bottom of some of those 100-to-200-foot-deep-lakes say the bottom water is as warm as 72° F.

Those measurements mean that in the austral, or Southern Hemisphere summer, when the ice atop

Over a period of thousands of years, these eerily beautiful sculptures have been carved by wind-blown sand and ice crystals out of naked rocks scattered about the Antarctic dry valleys. Snow almost never reaches the ground there because hot air rising from the exposed surface evaporates it before it can ever touch the earth.



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some of the glacier-fed lakes melts completely, the difference between the temperature of the air above the lakes and the temperature of the water at the bottom may be as much as 80 to 100 degrees.

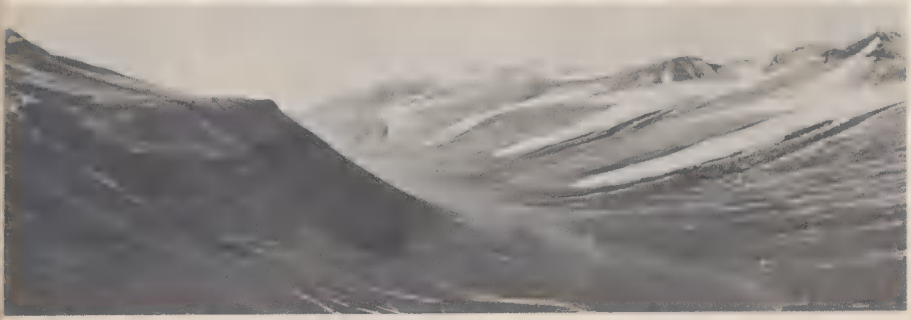
In winter, when temperatures in the dry valleys are estimated to drop well below minus 70 degrees, the difference in temperature between the air above the ice-covered lakes and the bottom waters is estimated to be as much as 150 to 200 degrees.

Just why these "oases" of dry-bare rock exist within the desert of snow and ice that covers almost all of Antarctica is still a mystery.

Glaciologists, seismologists, geologists and meteorologists all have their own preferred versions or combinations of explanations as to how the dry valleys came to be and why they remain dry and snow-free to this day.

Those valleys will be more and more in the news because:

1.—The National Aeronautics And Space Administration hopes to establish bases in either the Taylor or Wright dry valleys for: (a) testing equipment that could be used to detect any form of biological life on the moon and Mars, and (b) bases that could be used to test, under actual conditions of cold and



Limnologist above makes radio contact with the McMurdo Station, main U.S. outpost in Antarctica, a move vital to every field scientist. Glaciers (below) on valley slope maintain a constant position because they ablate at the same rate that they are fed.

darkness, moon drills—like those developed by the Martin Company and Westinghouse plants in Maryland. Those drills would enable geologists to take samples of the material inside the moon.

2.—The growing belief of a number of Antarctic experts that the United States will soon need another "main" supply depot in Antarctica either to replace or supplement the main U. S. Navy base now located at McMurdo Station on the southernmost tip of Ross Island.

One proposed site for such a base is at Marble Point, a snow-free, bare rock area within a few miles of both the Taylor and Wright dry valleys. The valleys are some 60 to 70 miles from McMurdo Station.

The Taylor Glacier which hangs, or flows, above the Taylor dry valley is at least 35 miles long and from 2 to 10 miles wide, according to experts at the United States Geological Survey. (U.S.G.S.).

It flows from the 8,000 foot high plateau of Victoria Land, in what is called New Zealand's Ross Sea Dependency, down to within 20 miles of the Ross Sea Ice Shelf.

There the glacier suddenly and abruptly ends. The dry valley containing the mysterious lakes with warm, bottom water continues below the glacier, gradually widening until its snow-free rocks meet the Ross Sea Ice Shelf.

The mountains to one side of the glacier and its dry valley are marked by peaks some 3,000 to 6,000 feet high. These mountains are called the Kukri Hills, because early British explorers thought the shape of the hills resembled the Kukri, or a Gurka sword.

Scientist, above, examines a recently discovered seal corpse. Below, 1,000-year-old skeleton of seal that also erred in wandering from sea to frozen bed of valley.

The hills to the south of the Taylor Glacier and its dry valleys are the northern foothills of what is called the Asgard Range which has peaks up to 6,500 and 7,500 feet.

There are two curious things about the Wright dry valley:

1—The valley, about 30 miles long and up to 10 miles in width, lies between two glaciers, the upper Wright Glacier and the lower Wright Glacier. The lower Wright Glacier extends from about 12 miles

from the western end of the dry valley until it merges into another larger glacier that flows into the Ross Ice Shelf.

2—The Wright Dry Valley contains what is thought to be one of the few rivers, if not the only river, known in Antarctica.

It is called the Onyx River, because of its color. In summer melt water from the upper Wright Glacier flows freely—if briefly—through the riverbed, New Zealand experts say.

Volcanic activity of the past and present may have had something to do with the creation of the dry valleys of the McMurdo Oasis, according to two groups of scientists.

Glaciologists say that sometime—about 150 million to 200 million years ago—beds of unusually strong and hard rock were uplifted or laid down at what is considered the heads of the dry valleys.

Then, for some still unknown reason, when Antarctica became covered with ice, that hard rock formed dams which prevented the glaciers from flowing freely down the valleys.

The part of the glacier that did flow over the hard rock was thus much thinner than the part of the glacier dammed up behind the rock.

In time the thinner glacier was "starved" of its parent ice and gradually evaporated due to the katabatic, or down slope winds, that roar through the valleys of Antarctica at speeds over 100 mph.

Once the glacier evaporated, the bare rocks became so warm in summer that it was impossible for snow to accumulate in quantity. Similiarly, the theory goes, strong winter winds sweep the areas free of snow during the Antarctic night.

That is the outline of the conventional—if unsatisfactory—explanation of the dry valleys.

Seismologists, particularly those of New Zealand, are not too sure the glaciologists' answer is the complete or even the right one.

The seismologists note that the McMurdo Oasis contains 13,000-foot-high Mount Erebus, Antarctica's famous active volcano. A new one, Mt. Melbourne, has just been found.

They also say that studies by scientists of several nations—including Russia, New Zealand and the United States—have indicated that the earth around Scott Base, at Pram Point on Ross Island, has the highest heat flux of any other spot that has been measured in the world.

That means, the New Zealanders explain, that the temperature of the earth under the base increases more greatly with depth.

Some scientists suspect that a high-heat flux beneath the dry valleys may be the reason why the glaciers suddenly end and the dry valleys begin. Seismologists are also not quite willing to accept the explanation geochemists offer: That the warmth of the water is due to the heavy salt content of the bottom water and to the fact that there is very little, if any, mixing of the lake water by vertical convection or by circulating currents.

Sewage treatment in space

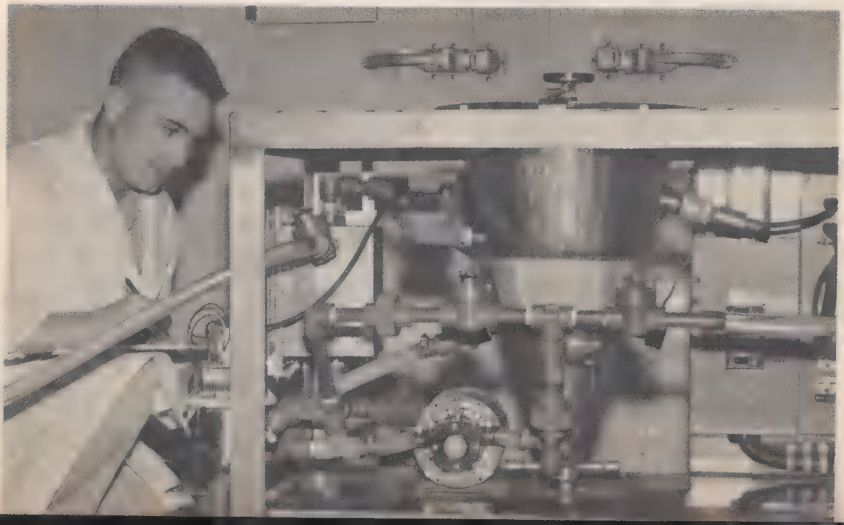
"WHERE man goes, there go his sewage problems." The man who made that statement knows what he is talking about. He is Lt. Michael J. Ryan, a sanitary engineer, one of the task scientists working on an experimental model of a closed ecological environmental system for space.

"As missions become months and years rather than days and weeks," continues Lt. Ryan, the demand on life support systems becomes more acute. The complexity, size and weight of these systems could overshadow and possibly limit man's exploration of new frontiers in space."

On earth, man and other animals are in an ecological balance with plants and various microorganisms. This means that the waste products of one group serve as an energy or food source for the other group and vice versa.

It is the job of Lt. Ryan and his associates to try to duplicate such an ecological balance in the cramped quarters of a spacecraft. So far they have built two separate systems at Brooks AFB, Tex. One is the world's smallest operational sewage treatment plant—comprised of two units about the size of two orange crates. The second system is a special facility for growing algae. Algae use the human waste gas of carbon dioxide and men use the algae waste of oxygen. In addition to waste treatment, this small version of the natural cycle would provide food for spacecraft occupants. Scientists estimate that it will be about a year and a half before systems are joined and operating with men.

Tiny operational sewage treatment plant at USAF School of Aerospace Medicine will eventually be combined with ecological unit to be used in long-term space project.



The most interesting fish in the world

AFTER a year and a half of diplomatic negotiating with the Australian government, The Aquarium of Niagara Falls has finally acquired one of the most interesting and one of the rarest fish in all the world—the Australian Lungfish (*Neoceratodus forsteri*, above).

This "living fossil" is the most primitive of all lungfishes and is only fish representative of its type in existence. It is a unique example of evolution because its relatives, which are now extinct, look very much like those creatures which evolved into the first land vertebrates.

The Australian lungfish is characterized by a plump body, paddle-shaped tail, paired fins, small eyes, and teeth that resemble crushing plates. Some individuals grow to a length of over five feet. The large thick scales afford the fish almost complete protection from its enemies in nature, but they are little help in protecting it from man. Early Australian settlers found the fish not only edible but delicious despite its unappetizing appearance. Settlers caught them in such abundance today they are nearly extinct.

Because the Australian lungfish lived in the Dawson River which is prone to dry up during the dry season, it has developed an unusual set of "lung sacs" which enable it to survive in the small, sluggish, stagnant oxygen-deprived pools of this river bed. The creature's "lungs" are filled with air every 30 to 60 minutes during the dry season, enabling it to adapt to its habitat and survive on atmospheric air alone.

The "lung" in a lungfish is in reality a modified air bladder, which supplements the gills as an organ of respiration.

Two other closely related fishes have similar structures; they are the South American and African lungfishes. While the habits of the Aus-

tralian lungfish are virtually unknown, the more common African variety has been very throughly studied. It lives in swamps and marshes, and occasionally comes to the surface for air just as the Australian lungfish does. But when the weather gets really hot and the swamps dry out completely, the fish employs a really remarkable survival technique. It burrows into the mud and curls up with its nose toward the air. There it lies, dormant, breathing through a small hole in the caked mud and subsisting on accumulated fat, until there is enough water in the swamp again to soften the mud and release the fish.

This adaptation has made the African lungfish very easy to ship to distant places. The fish, encased in brick-hard mud, can just be sent dry without injury. The mud only need be watered to revive it.

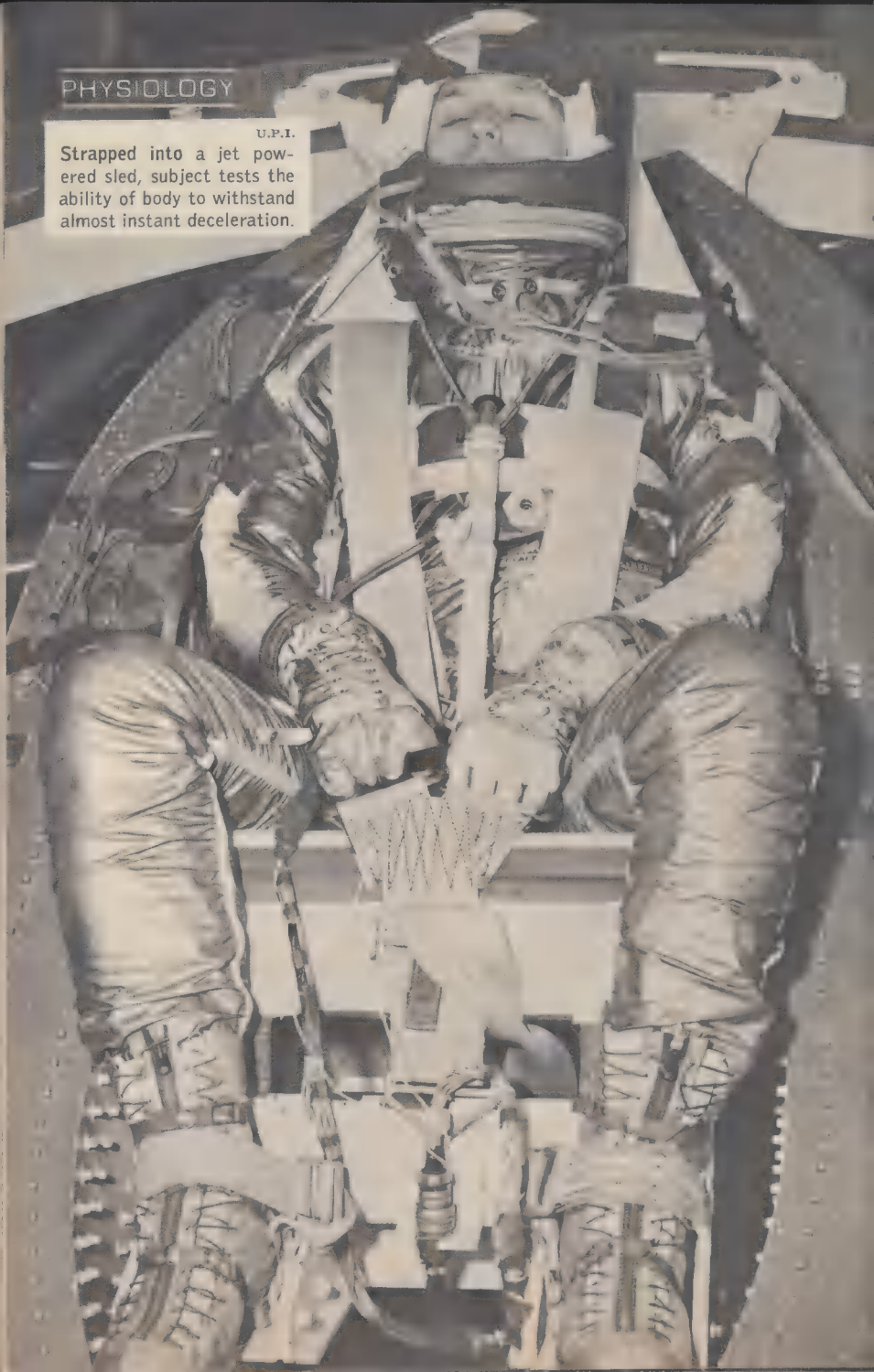
Both African and South American lungfishes resemble the Australian, except that their scales are smaller and the fins are narrower.

But of the three it is the rare Australian lungfish that is by far the most interesting from a biological point of view. It closely resembles other members of its family which lived in the Triassic and Jurassic periods, more than 125 million years ago. The two other lungfishes are only remotely related to those that existed in the distant past.

Slaughtered by man

The Australian lungfish was completely unknown until 1871, and then, after surviving for so many millions of years, it barely survived its first brief but violent encounter with man.

The lungfishes are not considered direct ancestors of the amphibians, the next step in the evolutionary ladder, although, like the amphibians, they pass through a larval "tadpole" stage where they breathe exclusively through external gills. Rather lung-fish and amphibians are considered parallel forms, but the parallelism gives scientists further insight into the development of the first land animals.



U.P.I.

Strapped into a jet powered sled, subject tests the ability of body to withstand almost instant deceleration.

How much can your body take?

Endurance limits in space

by William and Ellen Hartley

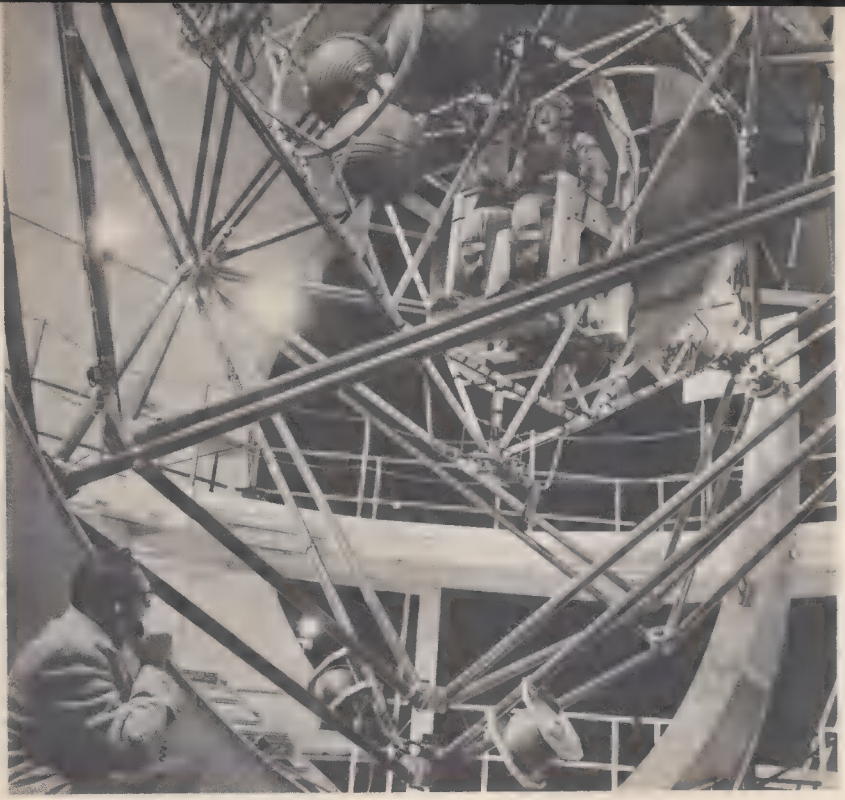
FROM the instant of lift-off, with its booster engines producing 7,500,000 pounds of punishing thrust in a maelstrom of ear-splitting noise, to the brutal slam of re-entry, Apollo 5 will subject three tough men to the outer limits of physical tolerance.

At peak acceleration, each man will weigh about one ton, or 10-12 times his weight on the earth's surface. Organ-displacing vibration will try to shake their innards apart. Once in the realm of silent space, their bodies will be subjected to the intense stresses of long-term weightlessness; pitching and tumbling will wrack their bodies; toxic gases in their sealed environment will take debilitating toll; silence and isolation will wreak its own curious havoc. Finally, the 5,000° heat of re-entry will radiate inside the capsule the maximum that a human body can stand and still survive—timed to the critical limit.

How much can a healthy human body take? Until lengthy space flights like Apollo have been successfully completed, no one knows the ultimate answers. But at aerospace medical centers throughout the country a clutter of weird devices, designed to impose on astronauts all of the stresses they will encounter, already have provided aerospace medical men with a sound background in the outside maximums to which they can subject their own charges. Now they are providing the medical profession at large with a far more accurate picture of the capabilities of the human machine. And despite all our shortcomings, we are tougher than we think.

What have the stress machines found out about your body?

Some years ago, in a dangerous experiment, an Air Force major named Eli Beeding rode a deceleration sled down a track at Holloman Air Force Base, N.M. When the sled slammed to a stop, Beeding experienced for a fraction of a second the in-



credible force of 83.5 times earth gravity. Although unable to walk away from the sled, the major recovered within a week.

Col. Paul Stapp, an Air Force physician, has provided evidence that man can survive a sudden stop from a speed of about 100 mph provided he is facing backward in the "eyeballs in" position, is semi-supine and properly secured, and is in a capsule that does not collapse on impact. (Predictably, he'll be badly hurt.)

At Brooks Air Force Base in San Antonio, Texas, home of the Aerospace Medical Division, there is a large tank in which men are placed to simulate some conditions of weightlessness. (A weightless condition cannot be truly *simulated* for an appreciable length of time on earth; some physiological aspects, however, may be approximated.)

After a period of immersion sufficient to decondition the subject to earth gravity—roughly, the situation encountered by astronauts in space—the man is checked out on a tilt table and then placed in a centrifuge capsule. Here he is spun on a hellish ride to induce prolonged and high G forces.

Studies of this sort have proven that during acceleration or deceleration, healthy males in properly positioned contour couches could tolerate G loads up to 10 or 12 times

Pictorial Parade

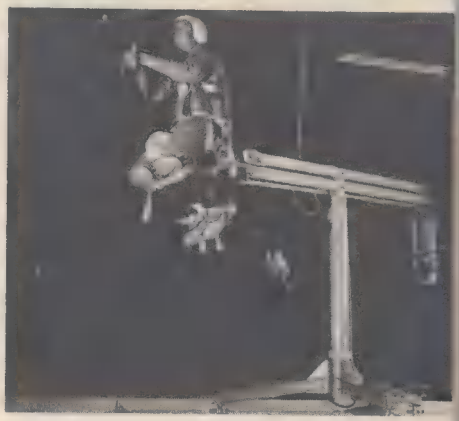
Prolonged rotation and its effects upon man are studied in this giant merry-go-round (above) at North American Aviation's Space & Information Systems Division. Volunteers have spent 30 days inside.

Pictorial Parade

Balance tests are conducted with this odd-looking device (right). Test subject is so delicately balanced that even the improper movement of one of his fingers can send him into wild sweeping gyrations.

UPI

Vibration is one of the most fearsome factors man in space faces. To find out how much can be tolerated scientists devised this giant rotating chair device (left).



earth gravity for two to three minute periods without grave discomfort. And with proper mechanical aids, even greater punishment can be survived. In June, 1966, Air Force pilot Al White was ejected from an XB-70 research plane that had been rammed in flight. White in his capsule hit the ground at an impact so great that his body weight, upon landing, was estimated at the equivalent of 5,700 pounds. Although gravely injured, he survived because his capsule survived —despite failure of the shock cushion to inflate.

Although the space program's human stress and tolerance studies have been conducted primarily—to get man safely in and out of space, the amount of information beneficial to average, earth-bound individuals has reached astonishing proportions. Some authorities note wryly that the loudest opponents of the space program have benefited, or will benefit in the future, from the very program they protest so strongly.

Acceleration and deceleration studies have hundreds of applications to ordinary people. Safer automobiles and planes already are on the way, based on these findings. The space vehicle itself, with its ablative shield, and a host of sophisticated materials and devices calculated to protect and sustain life, is already a treasure-house of

structural and materials information for industry.

The space suit, now so familiar to the public that it attracts little comment, is finding use in the treatment of vascular diseases. Sensor systems, devised to check on the physical condition of astronauts, are being used to monitor hospital patients. High speed dental drills, miniature microphones that may be swallowed or inserted in the body—these and countless other miniaturizations have emerged from the space program. One strange but typical spin-off: a smart nun at an Irish school for deaf children wanted some information on the perceptions of sound vibrations in the body. When her request reached the Manned Spacecraft Center in Houston, Texas, a computer sorted more than 100,000 studies and produced 16 that related to the particular problem.

Combinations of stress

We have barely stepped across the threshold of studies on how much the human body can endure. (Mercury and Gemini capsules went only about 30 miles higher than the publicly disregarded X-15 rocket plane). But space has already provided an almost perfect laboratory for studying normal, healthy individuals under stress and, more significantly, under *combinations* of stress and their interrelationships. It is a melting pot of psychological stress, heat, noise, lack of noise, isolation, etc., all stewed together.

Acceleration and deceleration. This was the first great manned vehicle problem, the initial double whammy. Until the space program got underway, an acceleration of from 3.5 to 5 G was considered the upper limit for humans. At this stress the heart can't pump blood to the head any longer. Result: no blood to the retina, followed by a phenomenon familiarly known as "blackout." But centrifuge studies soon indicated that forces of 12-15 G could be sustained briefly without injury. And man can tolerate accelerative overloads up to 80 G for brief instants under special conditions. Today we know that an astronaut can even control his craft under 8 G acceleration if he is properly positioned and the controls are close to his hand. Naturally, extreme G forces may not be tolerated for more than split-second periods, depending on the individual and his protection, but only suicidal studies could determine the exact limits. They would not mean much, either; a maze of other factors would distort any final figure. In summary, however, acceleration and deceleration tolerances are much higher than pre-space studies suggested.

Vibration. No natural phenomenon on earth produces this fearsome factor which is built into the shuddering performance of a big rocket enroute to the sound barrier. Worse is the high speed whirling and tumbling on re-entry. The gyrations create strains that can shift the position of a man's liver a full six inches. To determine how much

vibration a man can stand, volunteers have been tested on rotating chair devices reminiscent of giant kitchen blenders, flipped on tilt tables, whirled in a disorientation drum revolving on multiple axes at 60 mph.

At 3 G's a man is shaken so violently that every organ in his body wobbles wildly to all points of the compass under unbelievable stresses. It is unlikely that the average man will ever experience comparable vibration; but the information spin-off here relates to almost every aspect of internal medicine.

Weightlessness or zero-G. This has been the bugaboo of space effect questions. The length of time during which a man is weightless is the vital factor. Interrelated stresses tend to build each other over long periods, more or less as one drug increases the effect of another.

But the experience of the Gemini program, particularly the 14-day Gemini-7 flight (Borman/Lovell), has allayed many fears. Dr. Charles A. Berry, chief of Medical Programs at NASA's Manned Spacecraft Center, and authorities at the Aerospace Medical Division, now believe that weightless flights of 30 days may be sustained without damage.

In zero-G environment, grim things happen to people. The heart, not having to work so hard, relaxes. Blood pools, vein walls soften. Bones release calcium to the blood. There are serious shifts in body fluid level, muscular weakening, and such after-effects on re-entry as faintness and dizziness. A flabby heart can collapse on return to earth's gravity. Dehydration and weight loss were among the other considerations.

U.P.I.

Disorientation tests are conducted by G.E. to see how man reacts in a space environment where there is no real up and down.

Early in the space program, there was some evidence that "deconditioning"—a general weakening on long weightless flights—might have harmful effects, particularly during reentry.

But Borman and Lovell, who might have been expected to encounter greater troubles during their 14-day mission, actually emerged in better condition than most of their predecessors. This was due to exercise that tended to prevent decalcification and cardiovascular weakening, diet and water intake that reduced dehydration and weight loss, temporary freedom from space suits that permitted more rest and a lower perspiration output, and better sleep periods timed to familiar earth habits.

Vision and hearing problems, motion sickness and dizziness have

been far less significant than early predictions suggested.

EVA—extra vehicular activity—has created some concern. Cernan (Gemini 9) experienced fatigue outside the spacecraft, hyperventilation (abnormally deep breathing), and a heart rate that peaked at 180 beats/min. Earlier, White (Gemini 4) had caused some alarm when he peaked at 178. Collins (Gemini 10) came off somewhat better, peaking at 160 and experiencing little fatigue. But EVA provides all-important exercise. Currently it is being simplified through maneuvering devices that will cut down on energy output while permitting work to be accomplished. In early experiments a man with a power drill in zero G tended to spin in the direction opposite bit rotation—funny but frustrating. Today, he's being held in place by magnets or Velcro—a fabric with burr-like surfaces.

Solutions for calcium loss

What does all this mean to the layman? Essentially, the ground studies and weightless-sustained flights have given us new insights regarding decalcification, a problem that affects hospital patients during long periods of bed rest. Bones release calcium when stress on the body is reduced. This is eliminated as waste. But osteoporosis may be the ultimate result. Now doctors know that exercise has been demonstrated as a means of preventing the lazy, weakened heart.

Radiation. Largely because we have not yet encountered large amounts of radiation in space, we do not know exactly what the hazards will be. Missions so far have been below the Van Allen Belts.

Current thinking is that astronauts can whisk through this radiation barrier without serious danger, survive cosmic radiation, and even stand solar-flare bombardment. (They may have to; a solar-flare peak is due around 1970.)

These views are not guesswork, of course; satellites have produced information that tends to minimize the dangers of radiation in space. But it exists. As one answer to this problem, scientists are now contemplating drugs and ointments that may make the human body resistant to radiation. For obvious reasons, the Atomic Energy Commission has long been actively engaged in this branch of research. Information spin-off will doubtless have application in dermatology and cancer research.

Heat and cold. At Wright-Patterson and elsewhere, experiments have been conducted to determine the amount of heat and cold that the human body can endure. Reentry at 25,000 mph, moving from —450° F into dense atmosphere in a few minutes, runs the skin temperature of a capsule to 6000° F! To test people under such conditions, there is a heat-pulse oven in which the temperature can be raised to approximately 200° F. Subjects can stand extreme heat for brief periods when it has been built up quickly. Actually, a naked man

Eskimos can take low temperatures that would knock out other men; mountain people can work with little oxygen.

can take 500° for a few seconds. Tolerance limits of heat cannot be established exactly, however, because of the suicidal aspect of extreme experiments. Essentially, this is also true of cold.

The heat and cold problem, however, has produced some curious speculations. One is that man may be changed into a kind of Superman (the preferred expression is Optiman) who can adjust to extremes of cold and heat. This is not as strange as it sounds; we know that Eskimos are conditioned to low temperatures that would produce cold narcosis in individuals not adapted to sub-zero extremes. We also know that this is a matter of conditioning rather than race. Mountain men of every description are able to endure low temperatures as well as oxygen deficits.

The basic idea behind this radical speculation is to change man to meet space requirements.

Noise. Noise or the absence of it have been studied at Wright-Patterson and elsewhere. It appears that noise above 150 decibels (standing beside a jet engine will give you 110 decibels) blurs vision and has other deleterious but temporary effects on a subject whose ears are *protected.* A man exposed to 140 decibels for two minutes has suffered hearing loss for two hours. Pain is experienced at 120 decibels. Just to give a rough idea of sound effects, a riveter produces 105 decibels of clatter.

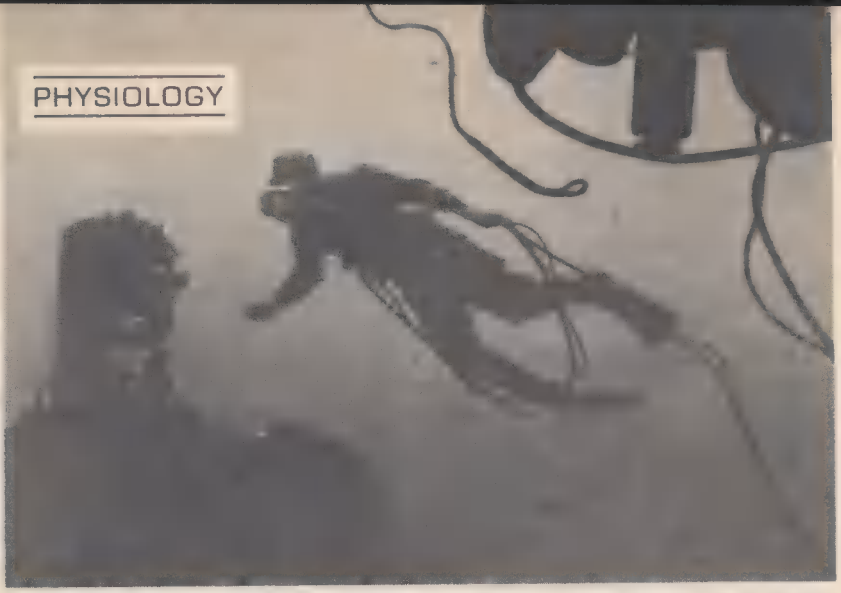
And yet the Apollo booster puts out 220 decibels at full thrust. In their module, the astronauts will be harassed with noise—190 decibels of sound—for a brief period. It will blur vision and heat the skin but the effects will be temporary.

Isolation. Some authorities think "cabin fever" may develop among astronauts during prolonged space flights. This is the isolation irritation and withdrawal that additionally affected some prospectors and explorers. An amusing story, related some years ago to the authors, involved two trappers in Alaska who fell out because they could not agree on the spelling of "ptarmigan."

In a recently reported experiment at the Naval Medical Research Institute at Bethesda, Md., nine pairs of men were isolated in small rooms for ten days. Two pairs could not finish the experimental period. Another pair were at the threshold of violence when experimenters stopped their outburst. There was a tendency in the isolated pairs to engage in lone activities and to establish territorial rights by the exclusive use of chairs and separate sides of the room.

But a great deal more must be learned about interpersonal stresses in isolation. So far, it has been difficult to define human tolerances accurately for mental and psychological stress.

PHYSIOLOGY



A diver forays against oxygen convulsions, cold, disorientation and other dangers of the deep, trailing a "hookah" hose linking his lungs to a diving chamber, right.

How much can your body take?

Endurance limits underwater

by Bruce Frisch

THERE will always be volunteers to dive deeper, says Jacques Cousteau, leader of the Conshelf experiments in underwater living; man is adventurous. He is also physically and mentally tough. How else could he have already survived a pressure of 470 pounds per square inch under 1,000 feet of black, cold, airless water?

As a species we can be proud of the physical part, but we can't take much credit for it. We just plunge in and it happens. Like whales, seals and ducks we automatically conserve oxygen. Our hearts slow. (Even our brain waves switch to a lower frequency.) And blood stops flowing to the extremities and goes only to vital organs like the heart and brain. The value of this diving reaction to vertebrates was proved by Richet, a French scientist, in a simple, brutal experiment. He tied the neck of a duck. It strangled to death in seven minutes. He then tied the neck of a second duck and held it under water. It lived 23 minutes, because its diving reaction made a lung full of air last longer.

Experienced divers develop other special adaptations. A breath-holding diver such as an instructor in the Navy's Submarine Escape Training Tank enlarges his lung capacity and uses a greater percentage of it in

breathing. What's more, he extracts a higher percentage of oxygen out of every breath. SCUBA (self-contained underwater breathing apparatus) and hard-hat divers learn to take long, slow breaths with a stretched out pause before exhaling.

It is even possible that some divers adapt to "squeeze." Squeeze happens when a diver goes down too far with tight-fitting goggles. Pressure throughout the body follows the pressure at the depth, but the pressure inside the goggles stays the 14.7 psi trapped inside at the surface. As a result, blood vessels in the eye swell and swell and—pop. Some divers may be able to let air into the goggles through the duct that connects the eye and the nose and makes our noses stuffy when we cry.

A mastery of sorts can be attained by professionals even over nitrogen narcosis. Cousteau named nitrogen narcosis "rapture of the deeps." "Nothing could be more true, or more French," says Stanley Miles, director of medical research at the British Royal Navy Medical School. "Unromantic British divers simply call it 'Narks.'" It is very much like being drunk or getting a whiff of laughing gas insufficient to knock one out. The effects are first felt at about 100 feet as the increasing pressure forces nitrogen into the blood and from there to the nervous system. At 200 feet, Miles says, a group of novices in a pressure chamber resembles "a happy gathering of revellers . . . a few may be incoherent and all are a little hysterical." The experienced, determined diver, on the other hand, keeps his "cool" even at 300 feet. He can't stave off his physical deterioration. He is clumsy. He takes longer, yet resents advice. He has trouble remembering his job and afterward probably won't remember anything. But he keeps going on sheer mental toughness. He would probably press on at 350 feet, says Miles, until he lost consciousness.

At the pressure equivalent of 460 feet there is no contest. When divers in a pressure chamber switch from special breathing mixtures to compressed air, reports Lt. M. W. Goodman of the Navy Medical Corp, "behavior transforms to the bizarre" within 20 to 60 seconds.

A diver doesn't have to go very deep, however, before the numbers of dangers arrayed against him and their interaction can turn his saving adaptations against him. For several reasons a diver has almost a chronic problem in flushing carbon dioxide out of his blood. But his body adapts, and he does not respond to the high carbon dioxide level by gasping for more air, as we on the surface would. This is good. Otherwise he might be in a constant state of anxiety. But "the central nervous system cannot adapt to the depressant effects of carbon dioxide," says Karl Schaefer, from the Navy Medical Research Laboratory in New London, Conn. "Achievement of carbon dioxide adaptation in diving is therefore considered a mixed blessing." The danger here is that the diver may

In saturation diving, divers are raised from the bottom in a pressurized "taxi" chamber (interior view, right), then passed to a deck chamber, left, where they decompress in comfort or live under pressure until it is time to return below for another shift.

slip off into unconsciousness from too much carbon dioxide without reacting to offset it.

Failure to react can also lay the diver open to the very thing the reaction is meant to guard against, a shortage of oxygen. Again, he could pass out. At the same time, his high tolerance to carbon dioxide makes the diver more susceptible to convulsions caused by *too much* oxygen. Clearly, in the tricky underwater world toughness has its limits. Smartness will have to help, if we're going to go deep.

As we descend, nitrogen narcosis is the first big obstacle. Nitrogen also causes the bends, so there is a double reason for getting rid of it. Bends is like opening a bottle of Coke. Under the extra pressure at depth nitrogen is forced into the blood and carried throughout the body. When the pressure is quickly released during a fast ascent, the tissues fizz. Starting often with a pain in the knee, bends can progress through paralysis, and if bubbles reach the brain, death. A slow ascent allows the nitrogen to pass out through the lungs without forming bubbles, but it means that a diver can spend most of his working day coming up.

Nothing is more bends-proof than oxygen. As fast as bubbles form, the tissues burn it up. But even at sea level or very shallow pressure depths pure oxygen kills in one to two days by damaging the lungs so much that at autopsy they look like a liver. Long before that point the diver would have an oxygen convulsion—in about 40 minutes at 35 feet with moderate exercise. The chief danger is its suddeness.

Diving physiologists have turned, instead, to substituting helium for nitrogen. Helium is one-eighth as narcotic as nitrogen, which means you can dive eight times deeper with it. To guard against oxygen convulsions as the depth increases, the percentage of oxygen in the mixture has to be reduced so that the oxygen pressure is never more than about two and a half times what it is at sea level. In the 1964 dive to 432 feet of Edwin Link's Man in Sea project the divers breathed 3.8 percent oxygen

compared to 20 percent at sea level. It took almost four days for the divers to decompress.

Decompression times like this are why the Navy, Cousteau and Link's Ocean Systems Inc. group are working out ways of living at great depths. Unless a diver can spend days or weeks at high pressure it isn't worth sending him down. Inside their underwater dwellings, divers find that the helium atmosphere makes the cavities in their heads resonate at higher frequencies, so their voices come out sounding like Donald Duck. Since helium conducts heat six times better than air, the men feel chilly unless the temperature is kept around 85° F.

Harmful effects of cold

Outside in the wet, cold is a much more serious matter. Water conducts heat 25 times better than air, on top of which a pound of water absorbs 1,000 times as much heat to raise its temperature one degree as does an equal weight of air. Unless the water is 96° F, almost body temperature, the body's heat will drain away. When inner body temperature drops only 1.8 degrees to 97° F, physiological malfunctions begin. At 94° F amnesia sets in. The one-quarter-inch thickness neoprene foam wet suit is designed to keep the core body temperature up for one hour in 32° F water. It won't keep the skin at 84° F, the comfort temperature; it will keep it around 58° F. This can be an insidious in-between. It's too cool to keep the body warm indefinitely, but it's too warm to let the body know it has to defend itself. If the body felt cold, it would shut off circulation to the surface, stemming the flow of heat to the surface in the blood and converting the outer layers to insulation. Instead, body temperature drops slowly, says Capt. E. L. Beckman of the Navy Medical Corp. "The individual has no idea of how he is doing. Subjects are all happy up to the time when they decide it is time to get out of the water, but then they are aggressive, are mentally cloudy and are not reasonable." To extend a diver's stay out in the cold the Navy used an electrically heated suit during Sealab II and has experimented with an isotope-fueled suit. For commercial work Westinghouse Undersea Division has made a suit through which warm water is circulated from a heater at the surface.

Other things are not what they seem either. In air we judge the direction of a sound by the fraction of a second longer it takes to reach one ear than the other. In water, the speed of sound is four times faster, and you can't tell where a sound is coming from. Attempts to regain a sense of direction, by effectively widening the space between the ears with horn-like extensions have failed.

Floating in his zero-"G" environment, continues Miles, the diver depends on his bubble trail and lighter water overhead to tell him which way is up. However, under the high pressures of deep diving every ex-

Jacques Mayol practices holding his breath in a Bahaman swimming pool in preparation for his record-setting dive to 198 feet, since surpassed. Pressure collapses chests of ordinary men below 85 feet, the fate of "thoracic crush."

halation may waste a gallon (at sea level pressure) of costly helium, so closed-circuit apparatus that gives off no bubbles is more common. Then, if deprived of his "sky," a diver may swim in circles, go up or down or turn over on his back. Like a pilot flying blind, he must swim on instruments, a depth gauge and compass.

None of these formidable problems is going to limit us in the near future. The one that probably will is the basic one of drawing a breath of fresh air. At seven atmospheres air is seven times denser. Every breath must be pulled in, pushed out. A big advantage of helium is that it is one-seventh as dense as the nitrogen it replaces. But a second effect of high pressure is that it takes a lot more extra work to breathe three or five times as fast as normal as it would at the surface. Thus, even with helium, very strenuous work is probably impossible below about 160 feet (roughly six atmospheres). "Breathing appliances that will actively assist the diver's respiratory efforts obviously deserve development and study, but there is reason to believe that there are definite limits to this approach," says Wood.

We can lighten the diver's work with propulsion devices and other aids. "However, a diver who cannot exert himself at least to a moderate degree becomes scarcely more useful than a TV camera with a remote-controlled manipulator."

Perhaps the diver of the future will take his oxygen right out of the water through a gill. Inventor Waldemar Ayres breathed through a gill made of sheets of polystyrene plastic for one hour. Using a more compact gill made of fine silicone rubber tubing, Bruce Bodell of the Chicago Wesley Memorial Hospital kept a rat alive in an underwater flask for 25 hours before stopping the experiment. In both cases the oxygen passes into the gill from the water and carbon dioxide diffuses out.

But who needs a gill when he has a lung, figures Johannes Kylstra, a Hollander now at the State U. of N. Y. at Buffalo, and a small band of other experimenters. They have kept alive animals that were breathing oxygenated water. Water, naturally, is a lot more dense and a lot more work to breathe than high pressure gases. Just breathing has killed rats by exhaustion. But Kylstra has kept mice alive as long as 18 hours. Keeping animals alive afterward in spite of lung damage is an even tougher problem, yet Kylstra has returned to normal lives dogs that have breathed water up to 52 minutes aided by gravity feed.

A diver wouldn't breathe sea water, of course. He would have to carry a carefully prepared solution, with mechanically assisted circulation and an oxygen bubbler (unless one imagines a second circuit consisting of a gill replacing the oxygen supply). The payoff for such complication would be in completely circumventing bends, since the diver would not breathe any inert gas. He could be yanked right off the bottom to the surface "without fear of bubble formation as a result of rapid decompression," Kylstra predicts.

The diver of the future may also have the aid of drugs. A drug for suppressing psychotic hallucinations has proved, in experiments, to help fight narcosis. Other drugs have had effect against oxygen toxicity and the bends.

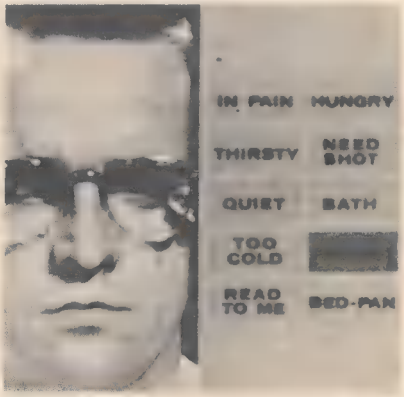
One of the most important things a diver will ever have going for him is hope. Kind-hearted old Richet proved it. He put rats in a tank of water and let them swim around until they drowned. Then he put in a second group of rats, but took them out just before they became exhausted. The next day these rats lasted twice as long—before drowning.

With science behind him finding ingenious ways to crash the barriers to the deep, why shouldn't a diver have hope? Just last year Cousteau revealed to a Washington symposium a new way to prevent inflammation and soreness of the ears caused by long submergence: "Don't wash them for two weeks before diving."

I'm giving him nose drops. Why do you ask?

Spinoffs from space

In order to help men survive at the very limits of human endurance, aerospace scientists developed an arsenal of highly sophisticated biomedical equipment. Obviously the results of some of this research are applicable to the improvement of preventive medicine, diagnosis, treatment and patient care on earth. Some examples are pictured below.



Technician (above) checks equipment for testing action of inner ear as reflected in eye movement and visual orientation. Spray-on electrodes (below) stick to patient even during exercise tests. Switch in glasses (above) actuated by eye movements allows paralyzed patient to signal needs. Respirometer helmet, similar to space helmet (below) allows doctors to make a detailed analysis of patient's breathing.

Tips and Trends

Longer shelf life for 13 fruits and vegetables is easily achieved by giving them a quick dip in hot water. The in-and-out treatment kills decay organisms without harming the fruit. Good results have been obtained by the U.S. Department of Agriculture with apples, blueberries, cantaloupes, citrus fruit, peppers, sweetpotatoes and mangos.

Irradication of Rh factor in disease, the conquest of hemophelia and use of steroid hormones to control glaucoma may be expected in the near future, say specialists in Medical World News.

Goodbye, alligator. Crass status-seekers, greedy for alligator shoes, bags and belts, may silence the mighty bellow that once roared from the mists of southern marshes. Poachers, hunting from aircraft, air boats and glade buggies, reap $1,000,000 a year from sale of illegal 'gator hides. Real estate operators are destroying the habitate by draining and filling the swamps.

Watch for new plant growth inhibitors that will do your pruning. It's a chemical that stops growth of terminal buds, but permits branching, on chrysanthemums, forsythia and junipers. It makes bushier, more compact plants if properly applied.

Weather forecasting by computer is here. The electronic brains are fed climate data from 143 cities in the U.S.A. and Canada. After analyzing and sorting the data, the computers print 12-60-hour forecasts of maximum and minimum temperatures for all the cities simultaneously.

Good Progress is being made against the top killer diseases -- heart, cancer and stroke --, according to Dr. Sidney Farber, Boston cancer specialist. The battle is being waged by a medical research team under federal grant.

Man is not going downhill

by Arthur J. Snider

To those prophets of doom who see mankind losing its stamina and becoming less hardy and efficient, a noted biologist counters with, "Who needs it?"

Indeed it is possible we could be less efficient than our paleolithic ancestors in their particular environments, but he points out:

"Is this a terrible loss? Except for roughing it during summer vacations, most of us in technologically advanced countries do not and need not face these ancient adverities. Nor, barring a breakdown of civilization, are our descendants likely to face them."

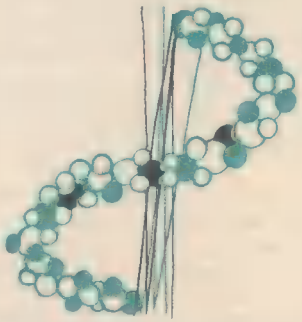
Dr. Theodosius Dobzhansky of Rockefeller University says he disagrees with "alarmists" who see a downward course of evolution because of bad genes.

It is true, he acknowledges, that advances in civilization's comforts and in the protection of the weak have caused a relaxation of natural selection responsible for man's hardiness.

But advances in medicine and technology are making it possible to supply genetic-based deficiencies of hormones, enzymes and proteins. Construction of artificial organs and breeding of laboratory animals to serve as donors of organs or tissues that can be transplanted to human bodies are in sight.

Furthermore, there are prospects that certain genes may be repressed or stimulated within the cell. Desirable genes could be "switched" on or off at will.

Dobzhansky rejects the proposal of some biologists to impose sterilization on carriers of bad genes. He prefers a "tender-minded form of negative eugenics" in which the



carriers of genetic defects are assured their condition is not their fault but at the same time are informed of the probable consequences of their begetting children. It is likely, he says, prospective parents would draw their own conclusions with good judgment.

Dobzhansky also rejects the idea of a "bank" in which to preserve sperm of noted men for insemination generations or centuries later.

"Positive eugenics schemes are shipwrecked on attempts to decide what sort of man is the ideal to be striven for," he stresses. "Does any-

one know what will be the best for mankind centuries or millennia hereafter.

"We all want men to be intelligent, compassionate, altruistic. But shall we endeavor to breed a race of brawny athletes or sensitive aesthetes or some combination of qualities, or a population containing certain proportions of each kind?

"It is easier to reach a consensus on which defects man would be better off without than to produce a blueprint of the ideal man."

Dobzhansky believes the movement of people across previous social barriers plus new emphasis on equality of opportunity will bring about marriages that will make possible "the realization of many hitherto concealed genetically-conditioned talents and abilities."

Fasting record

A new record for "no-calorie" dieting is claimed in the medical journal *Lancet*. A 281-pound woman in Scotland ate no caloric foods for 35 weeks and four days, losing 97 pounds. The previous record, published in the *Journal of the American Medical Association* in 1964 was 16 weeks and five days.

Two other women among 10 placed in a hospital for the diet therapy also broke the old record. They remained on the fast for 34 weeks and 20 weeks, respectively.

Only intake was water or tea or coffee without cream or sugar and vitamin tablets, which have no calories.

Dr. T. J. Thomson, who supervised the prolonged fast, said the most surprising aspect was how easily the fast was tolerated.

"Hunger was a recurrent sensation, most notable in the first few days," he said. "But thereafter it mostly disappeared."

Dr. Thomson concludes that the "starvation diet" is the most efficient method of reducing weight. Partial restriction of caloric intake is ineffective, he contends.

Rebuilt larynx

An artificial tube and valve fashioned from the patient's skin has enabled a 25-year-old Marine wounded at Viet Nam to speak normally without a voice box. Ordinarily, an individual who loses his larynx because of injury or cancer must attempt esophageal speech by which air is swallowed and then "burped" into the throat.

In the new operation devised by surgeons at Massachusetts Eye and Ear Infirmary, Boston, an opening is made at the top of the throat and valves formed from the patient's neck tissue. Then a tube made of thigh skin connects the valves to the opening at the former site of the larynx. The critical factor is the valves, since they must close perfectly. Otherwise fluid and food could enter the lungs.

Unlike esophageal speech, which takes months to learn, the Marine could speak almost immediately because of the normal flow of air.

Dr. William W. Montgomery who performed the operation, estimated 6,000 Americans lose their voice box each year because of cancer. However, general use of the new operation is still in the future, he said.

Thinking away warts

In folklore, warts are treated by tying knots in a string, rag or ribbon to equal the number on the skin. Another method is to count out beans or peas to the exact number. Is this kind of suggestive therapy effective?

It seems to be, replies Dr. Victor D. Newcomer, dermatologist at the University of California in Los Angeles. As high as 65 percent of all warts will disappear as a result of the patient's conviction that a particular treatment will be successful. But it is vital to the success of the treatment that the patient firmly believe the cure will work.

Transplanted hearts

Dogs have lived more than 48 hours on hearts transplanted from other dogs in experiments at the Medical College of Virginia, Richmond.

The success, even though short-lived, encouraged Dr. Richard J. Cleveland to predict that the first human heart transplant will occur within five years.

Ten dogs were involved in the experiment. One failed to survive surgery. One died 24 hours after the operation and the remaining eight lived more than 48 hours before the hearts stopped.

Cleveland said the experiments have demonstrated that a cadaver heart can be cooled and preserved long enough to be implanted and made to beat again in a new host. They also showed that the heart may not be as incompatible as other organs within a new host and thus less susceptible to rejection.

Body clock's effect on drugs

If animal findings hold true for human beings, the value one gets from taking a drug depends not only on the dosage but on the time of day the medication is taken.

A Chicago Medical School investigator finds the effectiveness of drugs appears to relate to the body's biological clock, the internal mechanism that regulates secretions and other metabolic activity in a 24-hour cycle.

Dr. Lawrence E. Scheving, professor of anatomy finds that when rodents are injected with amphetamine, they are more susceptible to its effects at one period in the 24-hour rhythm than in another.

For example, he has determined that as many as 78 percent die at certain hours from the effects of a lethal quantity of amphetamine and as few as six percent at other hours from the same dose. All rats were taken from the same colony and maintained under identical conditions of artificial day and night.

"When the data plotted graphically along a 24-hour time-scale, they show a period of high resistance to the drug and a power of lower resistance," Scheving reports. "Once the local clock-time of occurence for the crest and trough hours has been determined for a particular drug it can be predicted with reasonable assurance for other animals of the same species, provided the experimental conditions are kept constant."

Similar results have been obtained in his laboratories using other drugs such as nicotine, nembutal and strychnine.

Scheving believes a better understanding of the body's time structure could lead to safer and more effective drugs. He suggests that the therapeutic index of certain drugs, especially those having potent side effects, could be improved by designating not only the strength of the dose but also the "temporal scale," indicating what time of day the most effectiveness is obtained.

Four that lived

Four men with inoperable cancer of the prostate are alive and well today, more than five years after treatment with cobalt-60 and other super-voltage radiotherapy.

"They are apparently cured," says Dr. Juan A. Del Regato of Colorado Springs, Colo.

Dr. Del Regato, who has been given the gold medal, top award from the Radiological Society of North America, points out that most patients with inoperable cancer of the prostate have been considered hopeless in the past. Doctors can take only those measures to keep them comfortable and relatively free of pain.

But in 1962 Dr. Del Regato said he began to build evidence that supervoltage radiotherapy could achieve control of such cancers. Radiation has been by-passed up to now in favor of surgery or hormonal treatment because of the mistaken notion that prostatic cancers are resistant to radiation.

Now, more than five years after treatment, they are free of symptoms. He believes the treatment should be extended to others.

Stress triggers diabetes

Terrifying emotional experiences can trigger diabetes, in the belief of a French physician. He cites 10 cases of diabetes that developed in soldiers after an intensely stressful situation. In one, a grenade pin sprang loose. Another was in a nose-diving airplane that pulled out of a spin just moments before it would have crashed. In several of the other cases, emotional stresses experienced in day to day combat preceded the

development of diabetes.

Dr. Henri Felix of Lyon, a medical consultant to the French army, points out in *Medical World News* that association between stress and diabetes is difficult to prove because the early symptoms of thirst, weakness and weight loss usually are ignored by the patient until they become severe. The time between emotional shock and the apparent onset of the disease may vary from eight days to six months, according to the Lyonnaise doctor.

Medical Briefs

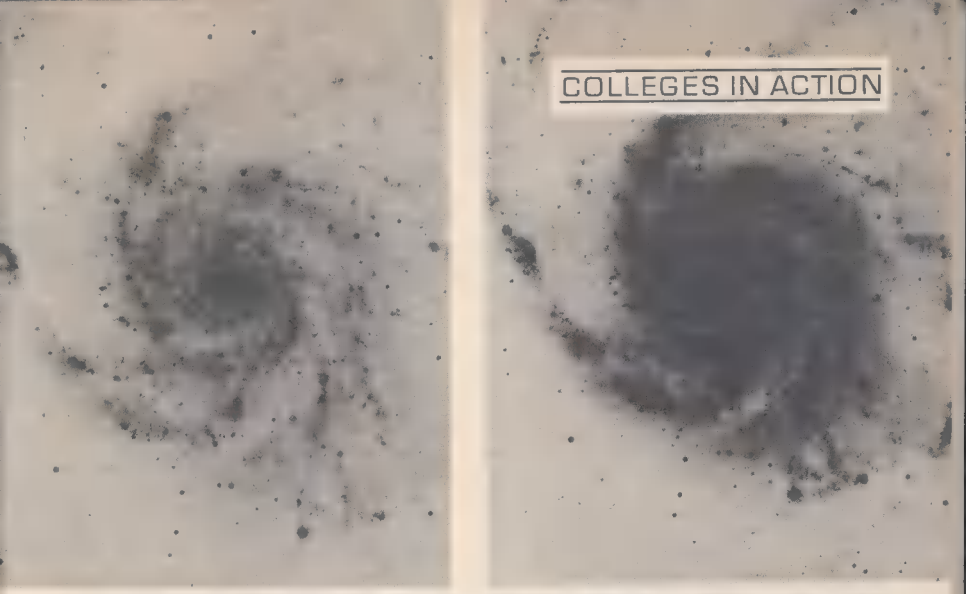
Cancer vaccine under test. A new anti-cancer vaccine, composed of human cancer tissue and gamma globulin from rabbits, developed by Rand Development Corp. of Cleveland, was used on more than 100 terminal cases recently. Already a number of the patients have outlived their predicted life expectancy; some have gone home under their own steam. The vaccine is designed to produce antigens that resist cancer cells. Rand will not comment yet, but they advise that no more patients can be accepted just now.

Pig parts for people. Heart valves from pigs and calves have been installed in people to replace their own diseased parts. Doctors at St. Vincent's Hospital in Melbourne, Australia, where the work was done, consider the animal valves more flexible than the plastic materials used in the past. Due to the thinness of the animal tissue, it is not rejected by the human body.

Atomic heart pacer. Development of an atomic-powered pacer to regulate offbeat hearts has been started, according to the AEC. Battery-powered devices now in use must be replaced by surgery at least every year or two. An atomic-powered device would last a minimum of 10 years.

Thumping the mumps. Nearly 11,000 people have been injected with a new, permanent vaccine against mumps developed by Merck Institute for Therapeutic Research in West Point, Pa. Some 7,000 more will be "shot" before spring. Results will go to National Institutes of Health for evaluation. So far, 98 percent of those innoculated have produced anti-bodies to fight the disease. If NIH findings corroborate this evidence, the one-shot vaccine may be available before the end of 1967.

Cancer drug checks rheumatoid arthritis? A daily oral dose of a drug called cycophosphamide, often used in treatment of lymph and bone cancers, has been found to control rheumatoid arthritis by interfering with the production of the rheumatoid factor, according to a report in *Medical World News*. The discovery, reported by Dr. William M. Fosdick of Holbrook Hill Medical Group in Tucson, Arizona, cites considerable improvement in the condition of 30 out of 38 cases of rheumatoid arthritis.



Dense mass of detail shows up in the photo (right) of the galaxy Messier 101, taken on new photographic plate. Thin photo at left, same telescope, is on older emulsion.

Sharper eye on the sky

EVEN on the darkest nights the sky glows in a faint veil of light caused by starlight scattered through Earth's atmosphere, and by "air glow" from charged particles bombarding the upper atmosphere.

This glow has been a curse to every astonomer who tried to photograph what he saw through his telescope. The longer the exposure (to catch faint details), the more the glow blackened the plate and obliterated the pinpoints he was trying to record.

Recently, William C. Miller, research photographer for the Mt. Wilson and Palomar observatories, operated by the *California Institute of Technology and the Carnegie Institution* of Washington, came up with spectacular pictures of the star-like disc of quasar 3C-48, verifying small protruberances emanating from it. They'd been seen, but never clearly recorded. More startling to the profession, the photos indicated that this quasar and another, 3C-273, are relatively close, small, and not associated with more distant galaxies. This was news. The mysterious quasars were thought to be way out on the edge of the universe—rocketing away close to the speed of light.

What made all this possible? A new photographic emulsion, developed in the Research Laboratories of Eastman Kodak Company. What they've done, Miller says, is to compound an emulsion that collects more information from faint objects before the air glow can

blacken the plate. It makes more efficient use of photons (bits of light) that strike it, providing higher contrast that pulls faint objects out of the glow.

The new plate enables the 200-inch Hale telescope at Palomar to reach much farther into space than ever before, and to see nearby objects in greater detail.

"It may prove the single most significant advance in astronomical photography in a decade or more," says Miller.

News from the quadrangles

Is America sinking?

Geologist Arthur Bloom, of *Cornell U.*, is visiting some remote Pacific islands to find out. He is part of a seven man expedition that will drill 200-foot cores to study old sediments, and check former coastlines.

During a six-year study of the Connecticut coast, he found evidence to conclude that the coastline is bending into the sea and has helped tides to rise four times faster in the last century than in the previous 1000 years.

Cygnus GR-1 bombards us

One year ago, a giant 3 million-cubic-foot teardrop balloon drifted into a Texas panhandle pig farm from a 23-mile-high mission. Behind it a heavy, four-foot egg-shaped cargo thumped and banged across the turf. Angered by the invasion, an army of boars charged the bounding "Humpty-Dumpty," tearing at it with tusks and hoofs. Luckily, they didn't get at the cargo.

The information it contained was retrieved intact by *University of Rochester* scientists who had lofted it. The data, recently analyzed by Professor Morton F. Kaplon and his research group, pinpointed the first area in space identifiable as a source of gamma radiation. They dubbed it "Cygnus GR-1."

Tiny packets of energy constantly bombard the earth as they zing through space. Since 1948, the Rochester cosmic ray group has been probing the skies to learn

Cosmic ray detector component, held by Dr. Kaplon, counted Cygnus ray collisions.

University of Rochester photo

where they come from. Scientists believe there may be some connection between the origin of cosmic rays and the radio stars. Moreover, since gamma rays may be produced by nuclear interactions of charged particles in space, study of gamma rays may yield data on the density of matter in space.

"Fowl bologna" on the menu

Latest thing in experimental lunch meats is a mix of red meat and chicken particles, arrived at by Dr. George Mountney, associate professor of poultry science at *Ohio State U.* The object: to produce a delectable but cheap meat loaf. According to Dr. Mountney, you can start watching for chicken hamburgers and chicken hot dogs, besides the bologna.

Quantum goes to work

Until now, quantum theory's greatest value has been in pure research, though its application to electronics gave us the transistor. Last January 150 scientists from 11 nations met at the *U. of Florida* to put quantum to work in helping to explain cellular mutations—a key to solution of the cancer riddle, involving the genetic code.

Toad's hometown nailed down

It took 12 years of research, but now we know. The world's toad population, genus Bufo has been traced back to its point of origin by *University of Texas* scientists under Dr. W. Frank Blair, prof. of zoology. "We can now say" reports Dr. Blair, "that toads originated in South America."

The effort behind Dr. Blair's study is aimed at basic evolution.

D-Day for great salt lake

Boats, balloons and 2,000 tin cans are afloat on Great Salt Lake. It isn't trash. The objects were launched by Professor John Edmund Fitzgerald of the *University of Utah* to help determine the chemical content of the fast evaporating waters in an effort to create a fresh water lake for recreation and conservation. The balloons will help determine surface currents; the cans, partially filled and buoyed below the surface will reveal submarine currents. Studies for building a dike and feeding fresh water streams into the stagnant pool to replace the salt are also under way. If it works, there will be a new era for the old salt pond.

Short skis for short legs

Young sports and slight adults stand a better chance of avoiding broken legs with shorty skis, according to a year's study of the subject by Dr. John Outwater, Jr. of the *University of Vermont.*

The research, under a U.S. Public Health Service grant, showed that twisting of the tibia—common cause of fracture—was greatly reduced by use of the new barrel-stave-length "boards."

Steel guard rail on Southeast Expressway (Boston) prevented runaway trailer truck from rolling down the embankment of right lane after it broke loose from its tractor.

The highway device that can save your life

A thick curtain of snow hit the New York Thruway between Buffalo and Rochester about noon on Sunday, January 30, 1966. Several vehicles spun out in the Batavia cut, collided and came to rest in a tangle. A tractor-trailer driver, forging along at 50 mph, caught a glimpse of the scrap steel, hit his brakes, slewed across the mall onto

Car skidding out of control on rain-slick Lakeland Freeway in Cleveland, was saved from brutal head-on collision by steel median. Massachusetts Turnpike Dep't. (below) is in process of erecting additional steel railing to an already well-protected throughway.

the opposing lanes and ran head-on into several cars that slithered around blocking all three lanes. By mid-afternoon, more than 100 cars had crashed into the growing wreckage; 70 were totaled. Miraculously, only one person was killed, but scores were seriously injured.

The median divider, a 30-foot-wide strip of lawn under a skin of snow, wasn't wide enough to do its job that day. Cars moving at 60-70 mph continually cross these strips when a driver "loses it" for one reason or another. (One young lady "lost it" on Connecticut's Merritt Parkway a few years back, and ran head-on into a car on the opposite side of the highway after crashing through 20 feet of thick shrubbery. She barely survived. The driver of the other car was killed. Under later interrogation, it turned out she was "putting on my stockings" at the time of the event).

The grim fact is that head-on collisions in which cars cross the median, if any, between lanes account for the greatest number of fatalities on the nation's highways.

Deaths from this cause have increased at a rate five times as fast

as that for all other highway fatalities combined during the last 20 years.

The National Safety Council has estimated that since 1946, 83,591 persons have died in head-on collisions, nearly equalling the number of Americans killed in World War I (53,513) and the Korean War (33,620). Such deaths have soared 175 percent in that span of time while total highway fatalities have jumped only 32 percent.

Records of state highway departments make it glaringly evident that even a wide median is virtually useless in high speed cross-overs. The Pennsylvania Turnpike's 10-foot-wide strip proved ineffective almost as soon as it opened. The Ohio Turnpike, since it opened in

1955 has recorded 13 cross-over collision fatalities with a 56-foot-wide median. A cross-over collision occurred on the New Jersey Turnpike in an area boasting a 96-foot-wide median.

As a result, for the past decade, safety engineers have been hard at work designing, building and testing devices to stop the calamities.

Steel rails of assorted designs and materials have been tried—mesh fences, some backed by steel cables, steel cables on posts, tubular steel, porcelain-on-steel, wood, aluminum and even snarled hedges of multiflora rose were raised. Today, one that works is emerging. It's a deep beam rail of tough, resilient steel that guides a rocketing vehicle down the highway the same way a slip guides a ferryboat to the landing.

This rail, which comes in sections 12½ feet long and 12¼ inches wide, is made stronger by a single deep corrugation running its entire length. It's fastened every six or 12 feet to galvanized steel posts. The beams are hung on both sides of the posts, usually set off from them by six or so inches so that the wheels of the vehicle may screech along the beams but miss the posts. This tends to keep the car or truck from spinning or from stopping instantly, an aid vital to passengers, since it is the impact from a sudden stop that often kills.

The beam-post structure, unlike solid concrete, acts as a continuous unit that yields on impact, absorbing shock and distributing it over the many separate pieces of rail. The cushioning effect will frequently redirect the vehicle intact back onto the roadway.

In areas where these rugged beams were first tried (long sections of the Pennsylvania Turnpike, parkways north of New York, etc.) fatality rates from cross-over collisions dropped by a staggering 30-90 percent between June 1965 and June 1966.

Naturally, cross-over accidents occur on two and three lane highways as well as on four lane roads, but only on the four lane highways can the separating barriers be utilized. Fortunately, they are the roads with the highest traffic concentration.

Even though the need for safety barriers is evident, there remain thousands of miles of newly constructed roads, not to mention old highways, that do not have this protection.

Miles of barrier unknown

Of the 69,273 miles of four or more lane highways in the U.S. highway system, at least 11,303 miles are described as "undivided;" that is, opposing lanes are separated by nothing more than painted lines. How much of the remaining 57,970 miles described as "divided" have unprotected medians is not known. Many of the 3,600 miles of the nation's toll roads do have effective median barriers. The rest of the highways, including the 21,000

Even trucks the size of the enormous car trailer (top) on Cincinnati's Mill Creek Expressway and the lumbering gas tank truck (below on Louisville's Watterson's Expressway) can't jump the resilient steel barriers to crash into the opposing lane.

miles of the Interstate Highway so far constructed, have traversable medians that still require safety barriers.

The Interstate Highway system, alleged to be one of the safest network of roads yet constructed and a boon to drivers, nevertheless has had so many cross-over collisions that individual states have seen fit to set up programs to install steel safety barriers.

The New York State Thruway Authority recently established a policy of erecting steel rail barriers on all sections of the median that are less than 30 feet wide. Oklahoma initiated a similar policy. The governor of Massachusetts has decided that any median less than 26 feet wide requires barriers. Use of steel barriers of one kind or another on highways and toll roads with traversable medians is becoming common practice in most states, and for good reason.

Connecticut's state highway department, at the order of Governor John Dempsey, has embarked on a program at a minimum cost of $4.6 million to install some 200 miles of steel median barriers on all highways that need them. Until now, the state had protected 100 miles of its highways, toll roads and Interstate roads.

Until March of 1966, the New York State Thruway Authority had only 27 test miles of protective median barriers. A project is now in the works to install 47 miles of guard rail wherever the center mall is less than 30 feet and another 58

miles in 300 strategic locations such as bridge piers, rock cuts, overhead sign supports. Total cost will be approximately $2.7 million.

Michigan intends to spend about $1¼ million to install barriers on specific sections of its share of Interstate roads.

The Massachusetts Department of Public Works has scheduled 67 miles of rail to be erected in 27 locations. In a separate move, the Massachusetts Turnpike is busy installing 11 miles of median barrier of a projected 85-mile program. The 12-mile extension of the Massachusetts Turnpike that terminates in Boston has an extremely effective double-faced steel barrier that runs its entire length.

Canada conscious of safety

Canada has also experienced a critical need for protection against cross-over accidents. Toronto has installed guard rails on several of its four-lane highways and has put up three separate two-sided steel barriers in the 12-lane section of the Macdonald Cartier Freeway that passes through the city. Other sections of the 510-mile freeway are getting similar treatment by the safety-conscious Province of Ontario.

The California Highway Department, which for 10 years has been investigating the cross-median accident program with statistical analyses and physical crash tests, received a National Safety Council commendation. More telling is the report by the California Highway Department that "fatalities due to cross-median accidents have practically been eliminated where barriers have been installed."

Aside from the obvious necessity to diminish traffic fatalities before they happen, states have a practical advantage in installing median barriers during original construction of interstate highways. If erected at the outset, Federal funds will supply 90 percent of the building costs. After the roads have been completed, any addition is regarded as a general improvement for which Federal funds are available on a 50-50 matching basis. And, because of rising costs of construction, narrower medians will have to be used and steel rail barriers will very likely become a must.

Unfortunately, even this promise of 40,000 miles of spanking new interstate road is not enough to alleviate the staggering amount of traffic pouring into the main arteries of travel. Construction of a cross-country superexpressway and expansion of present two- and three-lane highways to four or more lanes seems a necessity. (Though expressways per se are not solutions to congestion that strangles the flow of urban traffic.)

But just as necessary to a functional network of roads is recognizing what safety measures are needed and incorporating them into the building plans, instead of waiting to see whether the number of people killed is sufficient to warrant attention.

Want to be a success?

Here's what it takes

by David C. McClelland

Most people in this world, psychologically, can be divided into two broad groups. There is that minority which is challenged by opportunity and willing to work hard to achieve something, and the majority which really doesn't care all that much.

For nearly twenty years now, psychologists have tried to penetrate the mystery of this curious dichotomy. Is the need to achieve (or the absence of it) an accident, is it heredity, or is it the result of environment? Is it a single, isolatable human motive, or a combination of motives—the desire to accumulate wealth, power, fame? Most important of all, is there some technique that could give this will to achieve to people, even whole societies, who do not now have it?

While we do not yet have complete answers for any of these questions, years of work have given us partial answers to most of them and insights into all of them. There is a distinct human motive, distinguishable from others. It can be found, in fact tested for, in any group.

For example, several years ago, a careful study was made of 450 workers who had been thrown out of work by a plant shutdown in Erie, Pennsylvania.

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Most of the unemployed workers stayed home for a while and then checked back with the United States Employment Service to see if their old jobs or similar ones were available. But a small minority started job hunting. Why? Psychologists have demonstrated that these men possessed in greater degree a specific type of human motivation.

Let us refer to this personality characteristic as "Motive A" and review some of the other characteristics of the men who have more of the motive than other men.

Suppose they are confronted by a work situation in which they can set their own goals as to how difficult a task they will undertake. In the psychological laboratory, such a situation is very simply created by asking them to throw rings over a peg from any distance they may choose. Most men throw more or less randomly, standing now close, now far away, but those with Motive A seem to calculate carefully where they are most likely to get a sense of mastery. They stand nearly always at moderate distances, not so close as to make the task ridiculously easy, nor so far away as to make it impossible. They set moderately difficult, but potentially achievable goals.

But they behave like this only if *they* can influence the outcome by performing the work themselves. They prefer not to gamble at all. Say they are given a choice between rolling dice with one in three chances of winning and working on a problem with a one-in-three chance of solving in the time allotted; they choose to work on the problem.

Obviously they are concerned with personal achievement rather than with the rewards of success per se. This leads to another characteristic the Motive A men show—namely, a strong preference for work situations in which they get concrete feedback on how well they are doing, as one does, say in playing golf,

A simple ring test was able to separate motive A men from all others in the group.

or in being a salesman, but as one does not in teaching, or in personnel counseling.

But why do certain men behave like this? At one level the reply is simple: because they habitually spend their time thinking about doing things better. In fact, psychologists typically measure the strength of Motive A by taking samples of a man's spontaneous thoughts (such as making up a story about a picture they have been shown) and counting the frequency with which he mentions doing things better. This yields what is referred to technically as an individual's n Ach score (for "need for Achievement"). It is not difficult to understand why people who think constantly about "doing better" are more apt to do better at job-hunting, to set moderate, achievable goals for themselves, to dislike gambling and to prefer work situations where they can tell easily whether they are improving or not. But why some people and not others come to think this way is another question. The evidence suggests it is not because they are born that way, but because of special training they get in the home from parents who set moderately high achievement goals but who are warm, encouraging and nonauthoritarian in helping their children reach these goals.

Such detailed knowledge about one motive helps correct a lot of common sense ideas about human motivation. For example, much public policy(and much business policy) is based on the simpleminded notion that people will work harder "if they have to." As a first approximation, the idea isn't totally wrong, but it is only a half-truth.

N ach vs. n aff motive

A simple experiment makes the point nicely: Subjects were told that they could choose as a working partner either a close friend or a stranger who was known to be an expert on the problem to be solved. Those with higher *n* Ach (more "need to achieve") chose the experts over their friends, whereas those with more *n* Aff (the "need to Affiliate with others") chose friends over experts. The latter were not "unmotivated;" their desire to be with someone they liked was simply a stronger motive than their desire to excel at the task. The need for Power is often confused with the need for Achievement because both may lead to "outstanding" activities. There is a distinct difference. People with a strong need for Power want to command attention, get recognition, and control others. Those with high *n* Power are not as concerned with improving their work performance daily as those with high *n* Ach.

It follows, from what we have been able to learn, that not all "great achievers" score high in *n* Ach. Many generals, outstanding politicians, great research scientists do not, for instance, because they must be more concerned with power

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relationships. A research scientist must be able to go for long periods without the immediate feedback the person with high *n* Ach requires, etc. On the other hand, business executives tend to score high in *n* Ach.

You cannot trust what people tell you about their motives. Thus a general may say he is interested in achievement (because he has obviously achieved), or a businessman that he is interested only in making money (because he has made money), or one of the majority of unemployed in Erie that he desperately wants a job (because he knows he needs one); but a careful check of what each one thinks about and how he spends his time may show that each is concerned about quite different things.

Wherever people began to think often in *n* Ach terms, things begin to move. Men with higher *n* Ach get more raises and are promoted more rapidly, because they keep actively seeking ways to do a better job. Companies with many such men grow faster. There appears to be correlations between the *n* Ach content in popular literature (such as popular songs or stories in children's textbooks) and subsequent rates of national economic growth. A nation which is thinking about doing better all the time actually does do better economically speaking. Careful quantitative studies have shown this to be true in Ancient Greece, in Spain in the Middle Ages, in England from 1400—1800, as well as among contemporary nations, capitalist or Communist, developed or underdeveloped.

Contrast these two stories for example. Which one contains more *n* Ach? Which one reflects a state of mind which leads to striving?

Excerpt from story A (4th grade reader): "Don't Ever Owe a Man—The world is an illusion. Wife, children, horses and cows are all just ties of fate. They are ephemeral. Each after fulfilling his part in life disappears. So we should not clamour after riches which are not permanent. As long as we live it is wise not to have any attachments and just think of God. We have to spend our lives without trouble, for is it not time that there is an end to grievances? So it is better to live knowing the real state of affairs. Don't get entangled in the meshes of family life."

Excerpt from story B (4th grade reader): "How I Do Like to Learn—I was sent to an accelerated technical high school. I was so happy I cried. Learning is not very easy. In the beginning I couldn't understand what the teacher taught us. I always got a red cross mark on my papers. The boy sitting next to me was very enthusiastic and also an outstanding student. When he found I couldn't do the problems he offered to show me how he had done them. I could not copy his work. I must learn through my own reasoning. I gave his paper back and explained I had to do it myself. Sometimes I worked on a problem until midnight. If I couldn't finish, I started early in the morning. The red cross marks on my work were

getting less common. I conquered my difficulties. My marks rose. I graduated and went on to college."

Most readers would agree, without any special knowledge of the *n* Ach coding system, that the second story shows more concern with improvement than the first, which comes from a contemporary reader used in Indian public schools. In fact the latter has a certain Horatio Alger quality that is reminiscent of our own McGuffey readers of several generations ago. It appears today in the textbooks of Communist China. It should not, therefore, come as a surprise if a nation like Communist China, obsessed as it is with improvement, tended in the long run to outproduce a nation like India, which appears to be more fatalistic.

The ■ Ach level is obviously important for statesmen to watch and in many instances to try to do something about, particularly if a nation's economy is lagging.

Chinese seem obsessed with improvement while Indians tend to be more fatalistic.

If psychologists can detect *n* Ach levels in individuals or nations, particularly before their effects are widespread, can't the knowledge somehow be put to use to foster economic development? Obviously detection or diagnosis is not enough. What good is it to tell Britain (or India for that matter) that it needs more *n* Ach, a greater spirit of enterprise? In most such cases, informed observers of the local scene know very well that such a need exists. What is needed is some method of developing *n* Ach in individuals or nations.

Developing high achievement

Since about 1960, psychologists in my research group at Harvard have been experimenting with techniques designed to accomplish this goal, chiefly among business executives whose work requires the high *n* Ach action characteristics.

In broad outline the courses had four main goals: (1). They were designed to teach the participants how to think, talk and act like a person with high ■ Ach, based on our knowledge of such people gained through 17 years of research. For instance, men learned how to make up stories that would code high in *n* Ach. (2). The courses stimulated the participants to set higher but carefully planned and realistic work goals for themselves over the next two years. Then we checked back with them every six months to see

how well they were doing in terms of their own objectives; (3). The courses also utilized techniques for giving the participants knowledge about themselves. For instance, in playing the ring toss game, they could observe that they behaved differently from others—perhaps in refusing to adjust a goal downward after failure. This would then become a matter for group discussion and the man would have to explain what he had in mind in setting such unrealistic goals. Discussion could then lead on to what a man's ultimate goals in life were, how much he cared about actually improving performance by making a good impression or having many friends; (4). The courses also usually created a group *esprit de corps*. This membership in a new group helps a man achieve his goals, because he knows he has their sympathy and support and because he knows they will be watching.

Success courses

The courses have been given to executives in a large American firm, and in several Mexican firms, to underachieving high school boys, and to businessmen in India from Bombay and from a small city—Kakinada in the state of Andhra Pradesh. In every instance save one (the Mexican case), it was possible to demonstrate statistically, some two years later, than the men who took the course had done better (made more money, got promoted faster, expanded their business faster) than comparable men who did not take the course.

The promise of such a method of developing achievement motivation seems very great. It has obvious applications in helping underdeveloped countries, or "pockets of poverty" in the United States, to move faster economically. It has great potential for businesses that need to "turn around" and take a more enterprising approach toward their growth and development. It may even be helpful in developing more *n* Ach among low-income groups.

But a word of caution: Whenever I speak of this research and its great potential, audience reaction tends to go to opposite extremes. Either people remain skeptical and argue that motives can't really be changed, that all we are doing is dressing Dale Carnegie up in fancy "psychologese," or they become converts and want instant course descriptions by return mail.

For one, we have not yet learned how to develop *n* Ach really well among low-income groups. In our first effort—a summer course for bright underachieving 14-year-olds—we found that boys from the middle class improved steadily in grades in school over a two-year period, but boys from the lower class showed an improvement after the first year followed by a drop back to their beginning low grade average. Why? We speculated that it was because they moved back into an environment in which neither parents nor friends encouraged achievement or upward mobility.

Was Einstein wrong?

by Walter Sullivan

A leading physicist reported recently an observation that if true and correctly interpreted, would invalidate Albert Einstein's theory of relativity.

Dr. Robert H. Dicke, professor of physics at Princeton University, told a conference on astrophysics in New York that his observations of the sun last summer showed that its shape was flattened at the poles.

The effect of this flattening, or oblateness, is sufficient, he said, to explain a significant portion of the orbital behavior of Mercury, the planet closest to the sun, without recourse to relativity. It was the precise conformity of Mercury's orbit to Dr. Einstein's predictions that was the chief pillar of his theory.

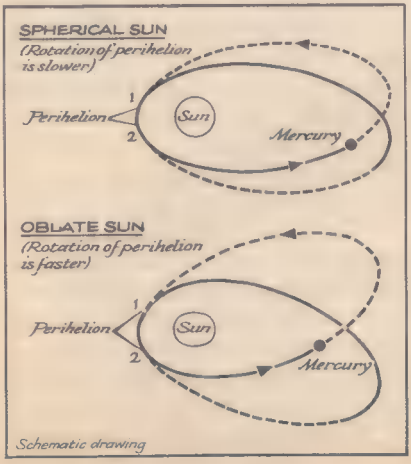
If Dr. Dicke is correct, this pillar has been undermined.

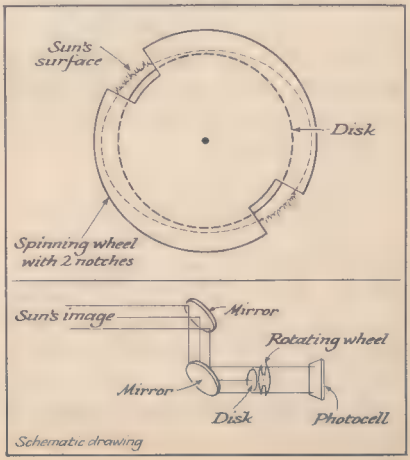
"It wouldn't surprise me," he said, "if general relativity is just plain wrong."

General relativity deals with gravity and its manifestations throughout the universe. This theory accounts for the bending of light by gravity and the "reddening" of light that emerges from a very strong gravitational field. However, testing the theory within the laboratory has been difficult.

The earlier contribution of Dr. Einstein, his special theory of relativity, deals with the relations be-

Irregular sun. A basic prop for Einstein's theory is a variation in the orbit of Mercury. The variation can also be explained if the sun is not a true but an oblated sphere (left) as Dr. Robert H. Dicke has discovered by means of a notched rotating sphere (right).





Dr. R. Dicke, prof. of physics at Princeton U., has theory that may usurp Einstein's.

tween energy, matter, time and the speed of light. Its validity has been demonstrated many times. One of the theory's best known equations is $E=MC^2$, energy equals mass multiplied by the square of the speed of light.

Dr. Dicke did not argue that the general principles of relativity do not apply to gravity, but rather that Dr. Einstein's theory, as formulated in his field equations, may be incorrect.

Dr. Dicke has himself played an important role in exploring alternatives, which he describes as tensor-scalar theories.

When Dr. Dicke's findings became known to physicists their reactions were related, to some extent, to their commitment to general relativity. The more skeptical pointed out that Dr. Dicke, as author of a rival theory, had a stake in proving Dr. Einstein wrong.

His supporters argued that he was a cautious and conservative experimenter. They were particularly impressed by the fact that his results were sensitive enough to show the effect of the earth's motion around the sun.

Because the sun's spin axis is tilted 7 degrees to the earth's orbit, the extent to which we can see any flattening of the sun at its poles varies during the year. When one pole of the sun is tilted towards us, the observed flattening would be at a minimum. When both poles are visible, in profile, the effect would be at a maximum.

This effect shows up clearly in last summer's observations, Dr. Dicke said.

The day prior to Dr. Dicke's talk before the huge photograph of Dr. Einstein hung on the wall behind the lectern. It was one of those sold in the Times Square area, along with giant pictures of Jean Harlow and W. C. Fields. It had been hung by parties unknown and before the closing session in the afternoon, it vanished.

At the start of his talk, Dr. Dicke said with a grin that he was not trying to put specialists in general relatively out of business. He was interrupted by Dr. George Gamow, the noted cosmologist now at the University of Colorado:

"Then what happened to Einstein's picture?" he cried, to the accompaniment of raucous laughter.

As noted by Dr. Dicke, the assumed effect of relativity on the motion of Mercury has been the one

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A huge picture of Einstein hung in the hall where Dr. Dicke read his theory. Afterwards it vanished.

precise piece of data supporting the gravitational theory of Dr. Einstein. It concerns the manner in which the point at which the planet makes its closest approach to the sun—the perihelion—migrates slowly around the sun.

The situation can be likened to the behavior of hula-hoops, which were the fad a few years ago. As one wiggles, the point at which the hoop touches moves slowly around the body.

In the case of Mercury the hoop represents its orbit. Mercury moves rapidly within that orbit, taking only 88 days for each trip. But the hula-hoop motion of the orbit, or perihelion rotation, is very slow—roughly 24,000 years for one circuit of the sun.

This motion is caused chiefly by the gravitational tugging of four planets: Venus, the earth, Jupiter and Saturn. They move Mercury's perihelion some 529 seconds of arc per century and the motions of the earth also impart a large apparent motion.

The result is that an apparent movement of 5556.68 seconds of arc per century is to be expected, without any contribution from relativity.

There are 3,600 seconds of arc to a degree and 360 degrees to a full circle.

Long before Dr. Einstein had formulated his theory it was known that the perihelion motion of Mercury's orbit was greater, by 43 seconds per century, than it should be in terms of conventional physics.

Dr. Einstein noted that Mercury is close to the sun and thus within a strong field of gravity. Using the field equations of his theory he calculated that relativity should give the perihelion an extra shove, amounting to 43.03 seconds of arc a century.

This was so close to the actual observation that his theory seemed to be dramatically confirmed. His theory also predicted that the light of a star, skirting the sun, should be bent 1.745 seconds of arc by the sun's gravity. Such a star could only be observed during a solar eclipse.

Such an eclipse occurred in 1919 and two British expeditions went into the field to see if stars were displaced from their normal positions by this effect. One came home with a displacement of 1.98 seconds; the other with 1.61 seconds.

The two observations fell on both sides of Dr. Einstein's prediction. They have been repeated many times since, Dr. Dicke pointed out, but the precision has never been comparable to that of the Mercury orbit as a test of the theory.

Dr. Dicke is widely known for his experiments in gravitation. The one described is the fruit of several years' preparation. It was performed with a vertical telescope that, through a system of mirrors, threw the image of the sun onto the ex-

perimental apparatus.

This consisted of a disk that cut out all of the sun's image except a narrow rim around its edge. Below this disk was a wheel, spinning at high speed, that cut off all light from the sun except for notches on opposite sides of the wheel.

At any moment in the wheel's rotation the light from two opposite regions of the sun's rim was able to penetrate the system, via the wheel's notches, and fall on a light-intensity recorder, or photocell. The disk was round and, if the sun, too, was round, the amount of light penetrating the system would have remained constant.

However, if the sun bulged around its equator and was flattened slightly at the poles, the light intensity would vary as the wheel spun, producing a flicker.

Such an apparatus was necessary, Dr. Dicke explained, because of formidable difficulties in observing the sun's shape. Its edge is made ragged by a variety of gaseous upwellings and eruptions. The brightness of its rim varies with sunspot activity and its equator is slightly hotter and brighter than its poles.

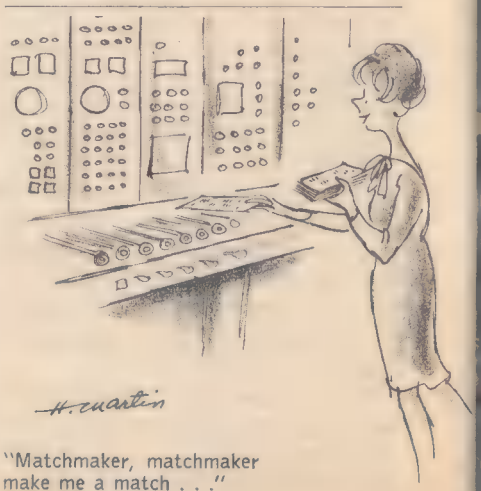
Dr. Dicke believes that, by spinning his wheel from 9 A.M. to 3 P.M. every sunny day, from early June to late September last year, he was able to average out or otherwise eliminate all of these effects. He found a flattening of the sun sufficient to give the orbit of Mercury a slight yank each time the planet passes through perihelion.

This is because a flattened sun would produce a gravitational field in nearby space, that is not perfectly uniform in all directions. It would be enough, Dr. Dicke said, to account for 8 percent of the movement of Mercury's orbit that had previously been attributed to relativity.

In other words the movement to be accounted for by relativity is 39 seconds of arc—not the 43 seconds generated by Dr. Einstein's equations.

The reason the sun is flattened, Dr. Dicke said, is that it appears to have a rapidly spinning core. The surface of the sun does not rotate as a solid body, but it takes roughly 28 days for a single revolution. The core, according to Dr. Dicke's calculations, spins once every 1.8 days.

The surface region of the sun, he believes, spins slowly because it is coupled magnetically to clouds of gas within the inner part of the solar system.



"Matchmaker, matchmaker make me a match . . ."

Instant airport

"To apply airfield, spray beach or jungle clearing generously. Allow to dry 15 minutes before landing aircraft." (See picture above.)

Those are roughly the directions for a new spray-on airfield material of great promise. It has been developed by Ling-Temco-Vought Aerospace Corp. for the Air Force.

Helicopters and the prospect of VTOL (Vertical Takeoff and Landing) aircraft have spurred the need for an airfield that is quick and easy to apply. If an aircraft does not require a runway, any clearing can be made into an airfield.

"Rapid Site" will withstand blast pressures of 2,500 pounds per square foot and blast temperatures up to 3,000° F. It does not turn to putty when the temperature of the outdoors climbs to 110° F. nor crack when it drops to zero.

The material is sprayed on the site. It drys and hardens in 15 minutes under normal conditions, within an hour under severe weather or temperature conditions. The liquid is a modified chlorinated polyester resin with fiberglas reinforcement and temperature resistant additives. It is also economical.

At the Air Force's Aero Propulsion Laboratory in Dayton, Ohio, a pad one-quarter inch thick and nine feet across withstood J-85 jet engine blasts equal to ten take-off and landing cycles. At another site, a base of fiberglas cloth was sprayed with fiberglas roving and the polyester resin. So far this 120-foot diameter pad has easily supported an Army Ch-37 helicopter and an

XC-142A VTOL, each weighing about 30,000 pounds. The helicopter flew around the edge of the pad repeatedly to see if the blade's downdraft would crack or break the edges. It didn't.

Test sites near Munich, Germany; London, England; Dallas, Texas, and Moffett Field, Cal., have successfully withstood wear.

In other uses, the spray can lay down a quick floor or storage base. One test built a quarter-inch shelter floor on top of soft sand. The floor stood up to use by autos, helicopters and a 17,500-lb. fire truck.

"Rapid Site" is fast advancing out of the experimental stage. In the future, it's easy to envision highways and streets, sidewalks, backyard swimming pools and patios, all stored in spray cans until needed.

A quarter-inch thick pad of "Rapid Site" above, is strong enough to support this 30,000 pound V/STOL aircraft when it finally lands. The polyester resin-base liquid has been sprayed on an area 120 feet wide at the LTV Aerospace Corp. plant in Dallas, Texas. Below, a mechanic holds up a skein of the resin and fiberglas material used to "build" the jiffy airfield.

U.P.I.

Document find. Dr. Jules Piccus (center), discoverer of the lost Leonardo manuscripts, and his dean, Dr. Edward More, listen while Dr. Ladislao Riti explains them to newsmen.

Science month

Leonardo rediscovered

An American scholar searching a Madrid library for popular ballads of the medieval period discovered some 700 pages of manuscript and drawings by Leonardo da Vinci, which had been lost for over two centuries. It looks as if the priceless documents had simply been misfiled.

Many of the drawings show a variety of complex machinery and indicate that Leonardo was the inventor of several devices including the chain drive.

The newly found documents substantially increase the amount of information available concerning the scope of Leonardo's genius. Prior to the discovery there were about 5,000 pages of manuscript available. However, scholars have estimated that three quarters of all his manuscripts are lost so that the extent of his genius will never be known.

Bats not blind

It is well known that bats navigate by means of highly developed echolocation systems. But the expression "blind as a bat" is not correct say two U. of Indiana scientists.

Roderick A. Suthers and Julia Chase tested Gray bats and Linnaeus bats and found that they were

able to distinguish visually between simple stationary patterns. The eyes of these mammals tend to be small and vision had been generally discounted as a useful sense.

"Pill" is for the birds

A scientist from the U. of Mass. and a chemical company are now conducting tests on a "pill" which they hope will become the most effective and humane method of controlling bird life in this country.

Dr. David K. Wetherbee believes that a compound called Sudan Black B, which has strong embryocidal qualities can decrease the population of nuisance birds, without harming the birds themselves. Capsules of the compound were inserted, by hand in 2½ tons of smelts, which were then spread over a sea gull nesting area in Nantucket Sound. The Sudan Black B destroys the embryos in gull eggs laid seven days after eating the fish.

The "pill" is not permanently effective, so the feeding operation would have to be repeated several times. But even one feeding serves to decrease the bird population. There are no harmful side effects.

Fume devices don't work

Starting next year all new autos will have to be equipped with fume control devices. California already requires such devices but the depressing conclusion that can be drawn from the California experience is that the gadgets don't work.

Los Angeles Air Pollution Control director Louis J. Fuller told the Senate Public Works Committee that many cars were exceeding legally permissable fume emissions after only 5,000 miles instead of the 50,000 miles expected.

Subliminal learning

Dr. Raymond S. Ross, professor of speech and director of the Speech Psychology Experimental Laboratory at Wayne State University believes that students can learn academic subjects under the disguise of a favorite TV show.

According to the speech specialist research at Wayne State has shown clear evidence that subliminal communication is possible.

"We have demonstrated its feasibility on standard video tape. The application of these findings are both frightening and exciting. At Wayne State the interest is in applications to painless learning."

Foreign language vocabulary words, for example, might be inserted into a program such as "Batman" and projected staccato onto the screen so that the viewer perceives the words subconsciously.

Researchers are now trying to begin studies linking subliminal communication and compressed speech (speeding up the normal rate of 130 words per minute to 750).

What the research group would like to do is find out if learning might not take place faster when "your conscious mind is not slowing you down," as Dr. Ross puts it.

Tackles the tough ones. Month after month Dr. Isaac Asimov bravely takes on the hardest science questions that Science Digest readers can throw at him. He has already explained light and the theory of relativity. This month Dr. Asimov explains one of the toughest concepts in physics.

What is parity?

SUPPOSE we give each subatomic particle one of two labels: *A* or *B*. Suppose, further, that whenever an A particle broke up to form two particles, those two particles would be either both A or both B. We could then write $A = A + A$ or $A = B + B$. If a B particle broke up to form the two particles, then one of those particles would always be A and the other B, so that we could write $B = A + B$.

You might discover other situations, too. If two particles collided and broke up to form three particles you might find that $A + A = A + B + B$, or that $A + B = B + B + B$.

Some situations would not be observed, however. You would *not* find, for instance, that $A + B = A + A$, or that $A + B + A = B + A + B$.

What does this all mean? Well, suppose you think of A as any even integer such as 2, 4 or 6, and B as any odd integer such as 3, 5 or 7. Two even integers always add up to an even integer ($6 = 2 + 4$) so $A = A + A$. Two odd integers always add up to an even integer, too ($8 = 3 + 5$) so $A = B + B$. The sum of an odd and an even integer, however, is always an odd integer ($7 = 3 + 4$) so $B = A + B$.

In other words, certain subatomic particles could be called "odd" and certain others could be called "even," for they form only those combinations and breakdowns which hold true in the case of adding odd and even integers.

When two integers are both even

or both odd, mathematicians say they are of "the same parity;" if one is even and one is odd they are of "different parity." Therefore when subatomic particles act as though some are odd and some are even and the rules of adding odd and even are never broken, that is considered "conservation of parity."

In 1927, the physicist, Eugene Wigner, showed that there was conservation of parity among subatomic particles, because those particles could be considered as having "right-left symmetry." Objects possessing such symmetry are identical with their mirror-images. The numerals 8 and 0 and the letters H and X have such symmetry. If you flipped 8, 0, H, or X so that right became left and vice-versa, you would still have 8, 0, H or X. The letters b and p do not have such right-left symmetry. If you flip them, then b becomes d and p becomes q—different letters altogether.

In 1956, two physicists Tsung Dao Lee and Chen Ning Yang showed that parity ought not be conserved, for certain types of subatomic events and experiments quickly showed they were right. This meant that certain subatomic particles acted as though they were not symmetrical under certain conditions.

For this reason, a more general conservation law was worked out. Where a particular particle was not symmetrical, then its antiparticle (with an opposite electric charge or magnetic field) was also not symmetrical, but in the opposite fashion. Thus, if a particle resembled p, then its antiparticle resembled q.

If the electric charge (C) and the parity (P) are taken together, then a simple rule could be set up describing which subatomic events could take place and which could not. This is called "CP-conservation."

Later, it was decided that in order to make the rule really fool-proof, one ought also to consider the direction of time (T), for a subatomic event can be viewed as happening either forward in time or backward in time. This is called "CPT-conservation."

In 1964, even CPT-conservation came into question, but no final decision has yet been reached there.

—Isaac Asimov

Are warts dangerous?

Ordinary warts are not dangerous, and almost all of us have them at one time or another. About half of these warts will eventually disappear even if untreated.

The wart is a viral infection of the skin and ordinary warts are not malignant and do not become so.

Adults are less likely to have warts than children. This may be the result of an acquired immunization—a build-up of antibodies that occurs as a person grows older. And, some people never get warts.

Warts are contagious. They can be transmitted from one person to another or spread to different parts of a person's body.

Warts can occur on any part of the skin, but most often appear on the hands, fingers and the soles of the feet. Those on the soles—plantar warts—cause the most trouble. Because of the pressure of shoes and walking, they are pushed inward instead of bulging outward, sometimes causing sharp pain.

Usually warts are treated medically only when they are tender, painful, when they interfere with functions of the body or when they are so located as to be unattractive.

The spontaneous disappearance of warts has often been linked in literature with suggestion therapy.

Last summer I visited a place in New Brunswick, Canada, where my car seemed to be able to roll up a slope from a dead start. How is this possible?

The spot in Moncton, New Brunswick where this happens is called "magnetic hill" although it seems certain that magnetism has nothing at all to do with the phenomena.

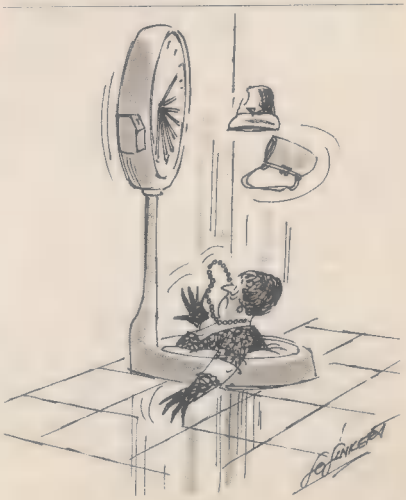
According to the National Geographic Society similar spots have been reported in New York State, Georgia, Florida, the Dakotas and other parts of Canada.

George Crossette, chief of the Society's Geographic Research Division says, "Investigations by scientists indicate that the phenomena described are usually the result of optical illusions. In some cases, the illusions are caused by the tilting of trees, houses and other objects due to a landslide in the area.

At Moncton the visitor drives to the top of a hill, stops his car and looks down a straight road. A big white sign stands about a quarter of a mile away. The visitor's eyes tell him that the sign is unquestionably at the bottom of a downgrade, descending at least 10 to 20 feet in the 400 or so yards.

But when the motorist releases his brake, the car does not coast. After stepping on the accelerator and eventually getting to the "bottom" of the hill, he does what the sign says: stops his motor, puts the gears in neutral, and releases the brakes. Incredibly, the car moves backward—coasting "up" the hill to where it started.

No one, it seems, has fully solved the puzzle of the Moncton hill, but the illusion may be a combination of factors such as the lay of the surrounding land, the contour of the road margins, and the angle of the grade.



Items in brief

Converting scrap. The U.S. Bureau of Mines has picked a site in Itasca County Minnesota on which to build a demonstration plant that will use automobile scrap to convert an unused type of iron ore into suitable blast furnace feed. Vast reserves of the ore called nonmagnetic taconite are found in that part of Minnesota. The demonstration plant, estimated to cost $4.5 million, will employ a Bureau-invented process that converts the ore to the more acceptable magnetic variety by roasting with scrap steel.

New frequencies for lasers (ruby and neodymian types) can be attained by a series of Raman cells developed by Union Carbide. Lab technician (above) is activating new cells with dimethyl sulfoxide liquid. Microscopic thermometer (below), a temperature sensor called a "thermistor" is dwarfed by a praying mantis, but it operates over a vast range.

Silicone rubber roll-on roofing will last 30 years. It's a boon from the laboratories of GE. The rubber goes on with brush or a paint roller. Silicone prevents drying and cracking. Domed roof in the Bahamas (above) is covered with the new material which permits collection of clean rainwater.

Radio paging via pocket-size radio receivers is being put into operation in 200 IBM offices throughout country. The object is to speed service to customers by diverting technicians in the field to new jobs. The dispatcher (right) keys her transmitter to send out an alert, which the customer engineer (above) hears. He then listens to her broadcast message. (Below). Twenty or more sections of metal pipe can be joined in an hour with new method.

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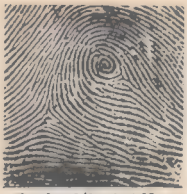
Is it too much to expect to keep up with it? It is for know-nothings. But for know-it-alls, here's a tip. **Take 18 seconds to fill out the above coupon and know it *almost* all for a year, or even two.**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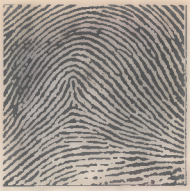
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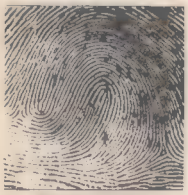
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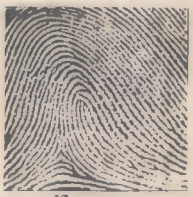
Loop

Your telltale fingerprints

by John and Molly Daugherty

MAY is the peak month for missing persons. Although most of them turn up (or are turned up) eventually, one in about 3,000 is a homicide. It is then that fingerprints are handy!

Aside from the fact that no one else has exactly the same fingerprints as you, what else do you know about dactyloscopy?

1. Years after you've touched a surface, your fingerprints may still be developed from it, conditions being right. The circumstance that does not affect how long your fingerprints last is
   a. The condition of the atmosphere
   b. The kind of surface where you've left your prints
   c. Your race
2. Latent fingerprints usually come from
   a. Oil from the sebaceous glands of your skin
   b. Excretion of normal perspiration
   c. Fine dust on the surface you touch
3. The fetal month during which you developed fingerprints was the
   a. Fourth
   b. Second
   c. Seventh
4. Of these men who contributed to criminology, the one who developed a method of identification different from fingerprinting was
   a. Sir Edward Henry
   b. Juan Vucetich
   c. Alphonse Bertillon
5. Classification of fingerprints involves primary, secondary and sub-groups. The primary gives a numerical value to whorls. The others use letters. The primary has two divisions—loops and arches (L) and whorls and composites (W). Prints of the ten fingers are bracketed into five pairs of two: right thumb and index, right middle and ring, etc.

   Possible combinations for the first pair are L/L, L/W, W/L, and W/W. Each combination of the second pair may combine with the first and so on through the fifth pair.

   The total number of primary combinations is
   a. 256
   b. 512
   c. 1,024

6. Fingerprints were first used
   a. For criminal investigation
   b. By individuals for personal identification
   c. By local police departments

7. The four major types of fingerprints in the Henry System are arches, loops, whorls and composities. The most common are
   a. Arches
   b. Loops
   c. Whorls

8. Friction ridges in fingerprints vary in size with age. Forgeot drew a line perpendicular to parallel ridge lines and counted the number of intersections in a 5 mm.-length of the line. The greatest number of intersections occurs in the fingerprints of
   a. Infants
   b. Twelve-year-olds
   c. Adults

9. When the friction ridges of a fingerprint form arches, loops and whorls, a single ridge line approaching the central pattern may bifurcate (form a Y and terminate). This is called a delta. The pattern normally having two deltas is the
   a. Arch
   b. Loop
   c. Whorl

10. The FBI has millions of fingerprints in its files. The figure closest to the number on file in Washington is
   a. 178,000,000
   b. 53,000,000
   c. 683,000,000

Answers:

1—c Your race. It can't affect how long your prints last.

Atmospheric conditions and the nature of the surface you touch can, however. You'll leave good fingerprints a short time after you've touched a smooth, nonporous surface, such as steel or glass, with sweaty, bloody or greasy fingers.

Brass is an exception. Although your fingerprints may seem invisible on brass, they'll show up later because of the etching from corrosion of the metal.

2—b Excretion of normal perspiration. The apex of the friction ridges on the fingers show pores which are the exit point for perspiration glands. Under magnification, the exact position of these pores aids fingerprint identification.

Sebaceous oil glands are associated with hair follicules. The fingers and palms do not secrete much oil, though the fingers may pick up oil from touching oily parts of the body.

3—a The fourth month, between the 100th and the 120th day. Before then, the fetus has absolutely smooth fingers.

A newborn baby's fingers, photographed through a prism, can reveal clues to possible brain, heart, kidney and lung abnormalities.

4—c Alphonse Bertillon. He was so much opposed to fingerprinting that France did not adopt it until after he died in 1914. He he designed a system of eleven body measurements to identify criminals. In 1895 London both fingerprinted and measured criminals.

Juan Vucetich did research on fingerprinting in Argentina. His classification system is still used for the most part in the great majority of Latin-American and Spanish-speak-

ing countries.

Henry, with the help of Galton's research, developed the fingerprint classification system basic (with a few modifications) to the systems used today in all English-speaking countries.

5—c 1,024. To get the fractional notation for the 1,024 combinations to put on the fingerprint cards, values are assigned for each whorl thus: for a whorl occurring in the first pair, 16; the second pair, 8; the third, 4; the fourth, 2; and the fifth, 1. These values are substituted in the formula for all possible combinations. For the first pair, W/L becomes 16/0, etc. Then numerators and denominators are added, too, but 1 is added to both numerator and denominator to take care of cases like L/L being O/O. Before the attained fraction is recorded, it is inverted.

6—b By individuals for personal identification, chiefly to prevent fraud. Clay tablets in China about 200 B.C. show fingerprints apparently used to identify the author.

Fauld published the first proposal for the use of fingerprints to identify criminals in 1880. In 1889 Scotland Yard adopted Henry's system of classification, which was an elaboration of Galton's work on fingerprints. New York police obtained the first fingerprint conviction in the United States on March 8, 1911.

7—b Loops. They comprise about 60 percent of all prints. Composites show features of two or more of the other varieties.

The loops start and end on the same side of your hand. Radial loops recurve toward the thumb. Ulnar loops slope toward the little finger. When the ridges make a spiral or complete circle, they are whorls with a double or single core. Arches are parallel ridges which arch toward the end of the finger as they run from side to side.

8—a Infants. Newborn babies have 15 to 18 ridges per 5 mm. Twelve-year-olds have 12; eight-year-olds, 13. Adults usually range from 9 to 10 ridges except when the hand is extra large. Then there are only 6 to 7 ridges per 5 mm.

9—c Whorls. In whorl formations one or more ridge lines completely recurve around the core of the print. They usually form two deltas. A delta can also form when two parallel ridges diverge. The point of divergence shows the location of the delta. A true loop has one delta, and plain arches have none. A tented arch may have a delta, however. The loop as a pattern appears on over 60 percent of fingerprints.

10—a 178,000,000. There were 178,942,227 fingerprint cards at the FBI last May, and of course the file keeps growing. The FBI files criminal fingerprint records separately from civil ones. Of course there may be duplications.

Score yourself:

9—10 right—Better join the FBI!
4— 8 right—Bone up on fingerprints.
0— 3 right—At least you know dactyloscopy isn't poetry.

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WANTED—MISCELLANEOUS

MERCURY-Gold-silver-platinum for cash. Circular. Ore assays. W-Terminal, Norwood, Mass.

LETTERS

Mr. Smith meet Mr. Hoover

I'm not sure where the name John Smith came from on my interview with the Director of the Agricultural Research Center? ("Tomorrow's New Foods," Jan., '66). The interview of course, was with Sam R. Hoover, Ph.D., Assistant Deputy Administrator of Nutrition, Consumer & Industrial Use Research.

VICTOR BLOCK
Bethesda, Md.

Mobot and Monster

Reading the article on the Loch Ness beasty ("Looking for the Monster," Jan '67) and the possibility of a giant sea slug being the cause made me recall a recent story in *Sea Frontiers.* The robot diver, Mobot, has televised and photographed a fifteen foot "object" that may be a "sea serpent." As such creatures do exist in the sea, then perhaps Loch Ness is only another habitat. There may even be a fresh and a salt water species. Send a Mobot to Loch Ness!

JAMES M. SCOTT
Redwood City, Calif.

An appeal answered

I am so happy you had the brilliant idea of publishing my letter requesting copies of Science Digest for our missionary libraries. I never expected that. And you would be surprised at the number of readers who have answered the appeal, and promptly too.

May the Christ Child bless all of your efforts in making mankind aware of the scientific discoveries which make this world a better place to live in.

SR. PAULINE-MARIE GRYSON
St. Theresa's Noviciate
P.O. Box 15
Pacdal, Baguio
Philippines

Shades of Hitler

"Some geneticists suggest betterment of the species should follow the principles of animal husbandry, relying on artificial insemination for stronger progeny."—*Science Digest* Jan. '67. Shades of Adolf Hitler! You must be joking. Where do I turn in my membership button to the human race?

JIM CHELIKOWSKY
Manhattan, Kansas

Science Digest did not recommend this practice. We were merely doing our job and reporting the fact that somebody else does. Ed.

Science for people

Regarding the article "Stay Young With Ions" (Jan. '67). This experi-

MISCELLANEOUS

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HOW To build a still. Humorous, factual, illustrated, 50 pages. Includes distillation, fermentation, wine, homebrew, taxes, etc. Over 25 recipes. $2.00. Buze, Box 490 E, Norman, Okla. 73069

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JOIN The Lost In Space fan club. Send 25¢ with your name & address. Ronald Korch, 9 3rd St., Passaic, N.J.

ment seems to demonstrate the health value of negative ions—fine. But the question is: How does a mere human, with limited scientific knowledge, benefit from this experiment.

I am sure many people who buy your magazine have a limited knowledge of science. The experiments make good reading, but people are interested in themselves—that is they are practical minded. Theories and experiments don't help much, unless one knows how to apply them to practical advantage. After all, the rats don't buy the magazine.

C. M. THOMAS.
Glendora, N. J.

Science Digest has the additional job of reporting new scientific findings which may, one day, be applicable to people.—Ed.

More UFO's

In your list of instructions on "What To Do If You See A Flying Saucer" (Dec. '66) I would like to point out that jumping to conclusions isn't relegated to the general public alone. Rule #2 states that "if you think you are seeing a spaceship. . ." Who's putting words in who's mouth.

There is certainly a lot of trouble and expense being assumed over these UFO's which are supposed to be swamp gas or hallucinations and are being seen mostly by science-fiction readers or drunken or hysterical people. If there is nothing but nothing to all of this, why all the uproar? It seems that there is a lot of credence being given something that is called incredible.

ELINOR NORTHUP
Youngsville, Pa.

After suffering through your article on UFO's I'm afraid that if you don't

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stick to reporting and examining the facts honestly, you may loose some of the discriminating readers you have attracted. I do not believe it can be the function of *Science Digest* to present opinions on scientific enigmas such as the UFO puzzle, whether they be frankly stated or subtly disguised, as they were in this instance.

In addition the article revealed ignorance and/or omission of important facts, besides the grossest misstatements of fact. This was one of the most insidious debunking jobs I have ever had the displeasure to read.

CHARLES S. CARLYLE
New York, N.Y.

Your article on UFO's was excellent. Though we at the Michigan Investigators of the "Flying Saucer" Phenomenon do not agree with all of it, we are glad that respectable magazines are finally giving the so-called "flying saucer mystery" the thought it deserves.

However, we did catch a small statement in the section "What To Do If You See A Flying Saucer," that we must sound off about. The last sentence says . . . "All saucer organizations have vested interest in having every sighting turn out to be a spaceship." Sorry. Our group has a "vested interest" in seriously explaining the object in a reported sighting, before labeling such an object as 'unknown." In fact, we have explained several that are still "unknown" on other saucer clubs lists.

We also recognize the fact that "positive unknowns" have been tracked on radar, that deaths have been caused by UFO's (not "flying saucers"), and that the investigation by the University of Colorado is not going to change much public opinion.

Here is one of our decisions that has set us apart from almost all other saucer clubs: We believe, as does the author of your article, that the Air Force and other government groups have very little restricted information on UFO's. We think it has some but certainly not enough to justify the charge of "sinister conspiracy" as others would have us believe!

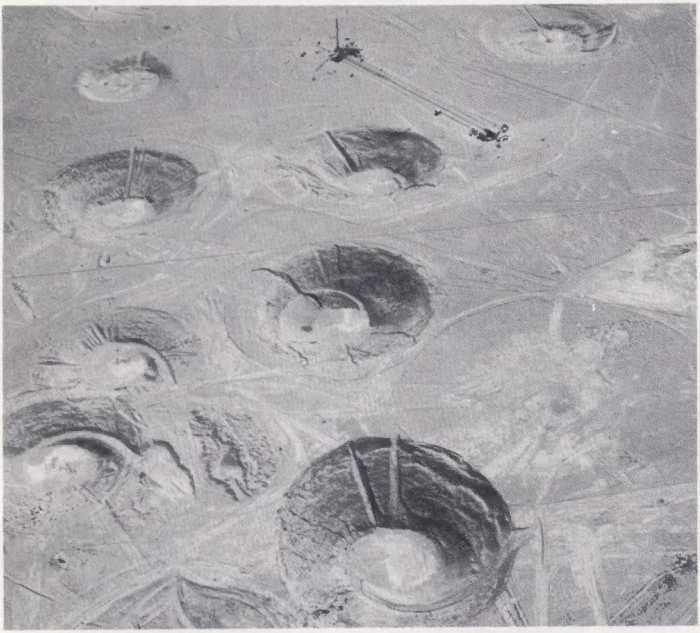
JOHN C. SHERWOOD
Marshall, Mich.

I visited the area in California shown in one of the UFO photographs you printed. The paved road at that point is about 24 feet wide. The ground under the object consists of loose dirt. There is a circular patch of cultivated soil next to the concrete pipe. You imply that the photo does not show a cloud of dust," but this dirt could form a "cloud of dust" under certain wind conditions. I am of the opinion that the "cloud of dust" exists and that the white area by the second pipe is a patch of loose soil.

KENNETH LARSON
Los Angeles, Calif.

The article entitled, "UFO's, What a New Investigation May Reveal." didn't hint at what a new investigation may reveal, to me. It revealed only skepticism and a rather patronizing attitude. You make me wonder seriously what sort of a science digest, *Science Digest* really is. It would appear to me that you have a very casual manner about dismissing anything you may find strenuous.

JACK BLOSSOM
Detroit, Mich.



Mooncraters?

THE photo above was not taken by the latest Lunar Orbiter. It is a view of Yucca Flat, locale for underground nuclear testing at the Nevada Test Site. The loose, gravelly soil, known as desert alluvium, usually caves in (decavitates) after a deep underground test, forming a huge saucer-shaped depression at the surface. The small black object in the upper portion of the picture is a drill rig preparing another test shaft. The site is 65 miles northwest of Las Vegas, and is an area that has seen more nuclear detonations than any other place on earth. Since June 30, 1966 there have been 278 blasts. The first nuclear detonation took place there on January 27, 1951. Since that time the test site has been used for a variety of nuclear tests. In addition to air drops, detonations have occurred from balloons, towers at ground level, and in shallow excavations. In 1953, an atomic artillery shell was fired from a cannon and successfully detonated. In 1957, an air to-air nuclear missile was launched and detonated over the site. But since the test ban treaty, the site has been used exclusively for deep underground tests, the only kind allowed under the terms of the treaty.

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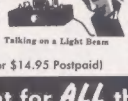

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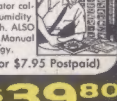

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